

PUBLIC WORKS

An Engineering and Construction Monthly

310 EAST 45TH ST.

NEW YORK, N. Y.

CITY

COUNTY

STATE

Vol. 61

February, 1930

No. 2

Table of Contents

Books and Book Reviews	42
Bridges	
Concrete Bridge Construction in Walla Walla County	59
Civil Service Examinations	40
Constructors and Construction	
Georgia to Prequalify Bidders	55
Public Works Outlay for 1930 to be 7 Billion	77
Prequalification of Bidders in Public Works	82
Prequalification of Bidders in Philadelphia	84
Conventions	37
Editorial	
Patented Pavements	79
Public Health Service Engineers	79
A Good Road Show	79
Equipment	
New Equipment	44
Equipment for Laying Large Cast-Iron Pipe	68
Flood Control	
Levee Construction by Tractor and Trailer Teams	47
Industrial Railways Build Levees	66
General	
Winter Sports in the Southwest	55
Build and Be Gone in Pennsylvania	57
Papers at the American Road Builders' Assn. Meeting	70
Highways and Pavements	
Construction Methods on Hornell-Canisteo Road	52
Boulevard Construction in San Francisco	55
Road Letting in New Mexico	58
Reconstruction of Highways in Massachusetts	63
Papers at the City Officials Session of the A.R.B.A.	70
County Highway Officials Session of the A.R.B.A.	74
Asphaltic Treatment of Sand-Clay Roads	81
Legal Decisions	85
Municipal Engineering	
City Engineering in Syracuse	80
Refuse Collection and Disposal	
Refuse Disposal in Baltimore	69
Refuse Collection not a Public Health Function	84
Sewerage and Sewage Treatment	
Gas Pressure Bursts Sludge Pump	56
Sewer and Water Work in Iowa in 1929	58
Ohio River Basin Water and Sewerage Discussed	62
Sewerage Deficiency in Chicago	78
Water Supply and Purification	
Washing Rapid Sand Filters	49
Illinois Sanitary Water Board	58
Water and Sewerage Improvements in Missouri	62
Equipment for Laying Large Cast Iron Pipe	68

With Our Contributors:

Most every one in the sanitary engineering field knows C. E. Keefer, whose article on page 56 brings up a new and interesting subject. He has been Engineer of Sewage Disposal of the Baltimore Bureau of Sewers for a number of years, and has been prominent in research and investigation in this field. He has been a contributor to this magazine for a gratifying number of years. . . . We welcome Edward R. Smith, engineer of Walla Walla County, Washington, as a new contributor. His article on page 59 presents a new and refreshing viewpoint of the relations between engineers and contractors. Mr. Smith is a graduate of Brown University in '15; he served with the 4th Engineers overseas during the war. He is active in engineering societies in the northwest, and a contributor to a number of magazines. . . . F. E. Cassidy, of the Massachusetts Department of Highways, is also making his first appearance as a contributor to PUBLIC WORKS, but he is no stranger to us. He has been in charge of construction on a number of highway projects during the past year, and is a close student of construction problems. . . . W. A. Stacey is engineer of Reno County, Kansas. The method he has worked out for asphaltic treatment of roads in his county should be of value to every county engineer confronted with similar problems.

For Next Month—

A feature of our March issue will be reports from nearly all of the more important cities showing in detail their proposed expenditures for 1930 as compared to the expenditures for 1929.

Subscription Rates:

United States and Possessions, Mexico
and Cuba \$3.00
All other countries \$4.00
Single copies, 35 cents each.

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

PUBLIC WORKS

Published Monthly

at 310 East 45th St., New York, N. Y.

Western Office: Michigan-Ohio Building, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer

A. PRESCOTT FOLWELL, Editor

W. A. HARDENBERGH, Associate Editor

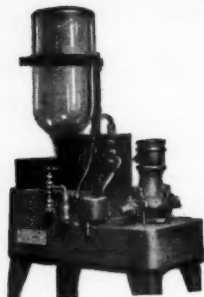
PUBLIC WORKS is devoted to the design, construction, maintenance and operation of public improvements.

The major subjects covered are: Highways, Water Supply, Sewerage, Refuse Collection and Disposal, Street Cleaning, Bridges, etc.

Every progressive step is accurately and faithfully recorded.



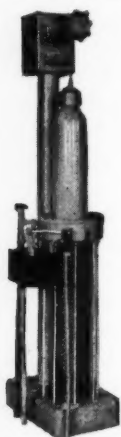
W&T CHLORO SCALE
Gives a continuous record
of chlorine used



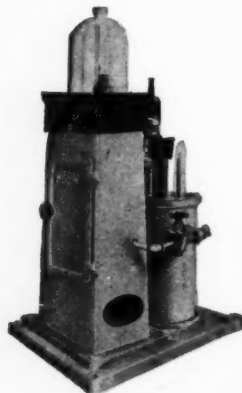
W&T CHLORO METER
For sterilizing small water supplies



THE LAVÉ PROCESS
For production of sodium hypochlorite sterilizing
solutions at laundries, dairies, food establishments



W&T CHLORO-CLOCK
Accurately applies chlorine
solution for swimming
pool sterilization



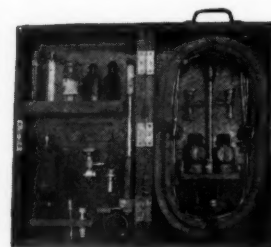
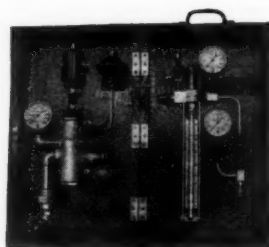
**W&T VACUUM
TYPE ASV AUTOMATIC
CHLORINATOR**
Especially applicable for water and
sewage sterilization where
flow fluctuates widely

Chlorinators for Every Need

WATER STERILIZATION
SWIMMING POOL SANITATION
SEWAGE DISINFECTION
ODOR CONTROL
ALGAE ELIMINATION
WATER MAIN STERILIZATION
INDUSTRIAL WASTE TREATMENT
DAIRY SANITATION
BLEACHING SOLUTIONS



W&T MSP TYPE CHLORINATOR
For sterilizing water supplies in small
communities and in swimming pools



W&T WATER MAIN STERILIZER
A new portable chlorinating apparatus which every water works should have

"The only safe water is a sterilized water"



WALLACE & TIERNAN

COMPANY, INCORPORATED

Manufacturers of Chlorine Control Apparatus

NEWARK - NEW JERSEY



NEW YORK CHICAGO KNOXVILLE SAN FRANCISCO MINNEAPOLIS PITTSBURGH DALLAS KANSAS CITY
LOS ANGELES SEATTLE ST. LOUIS BUFFALO INDIANAPOLIS DETROIT BOSTON JACKSONVILLE
CHATTANOOGA CHARLOTTE OKLAHOMA CITY PHILADELPHIA SPOKANE OGDEN
WALLACE & TIERNAN, LTD., TORONTO, CANADA WALLACE & TIERNAN, LTD., LONDON, ENGLAND

2-17

PUBLIC WORKS

CITY

COUNTY

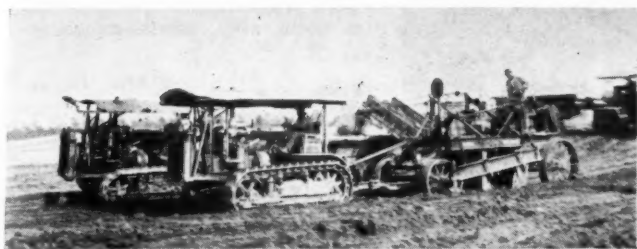
STATE

AN ENGINEERING AND CONSTRUCTION MONTHLY

Vol. 61

February, 1930

No. 2



Power Take-Off in the New Russell "60" Is Shown, Loading 7 Yds. a Minute Into Wagon Drawn by Caterpillar Tractor



Russell "60" Elevating Grader Loading Into La Plant-Choate 7-Yard Wagon; 4-Up Mule Team Ready to Step Up

LOWRANCE BROTHERS JOB

Levee Construction by Tractor and Trailer Teams

In the area east of Joiner, Ark., a considerable amount of levee construction has been carried on this year. The work here includes a new loop or cut-off levee across Pecan Point Neck somewhat over two miles in length, and five landside enlargement jobs in the area just south of Pecan Point.

The new construction across Pecan Point Neck involves a contract amount of 974,000 cubic yards, though actual construction will run about a million yards, as follows: Contract 11A, 353,000 cubic yards to Lowrance Bros. & Co.; 11B, 330,000 cubic yards to E. M. Lowrance; 11C, 314,000 cubic yards to E. H. Polk, who subcontracted part of the section to S. L. Hunter and E. M. Lowrance and did some work himself.

South of these jobs are contracts 41A, B, C, D, and E. Lowrance Bros. and associated firms were the suc-

cessful bidders on contracts 41A and 41C, and have completed these sections. Contracts 41B, D, and E were awarded to the Coastal Construction Co. This work, which is all landside enlargement of existing levees, involves the following amounts: 41B, 276,255 yards; 41D, 409,000 yards; 41E, 330,211 yards.

On all sections the contractors are using tractor and crawler wagon teams, in some cases supplemented by mules. The firms on contracts 11A, B, and C are loading their wagons with elevating graders, while the Coastal Construction Co. used small draglines.

Contracts 11A, B, C.—The levee on these sections was unusually high—in places as much as 30 or 32 feet—though the average of 11A is only 22.3 feet and the average height of the other sections is less. The dirt required for a 25-foot levee of the standard



Seventy-five Thousand Dollars of Equipment Dedicated to Levee Building on the Lowrance Contract. General View of One Borrow Pit



Coastal Construction Company's Koehring 1 1/4 Yard Dragline Loading Into 5-Yard Euclid Crawler Wagon, Caterpillar-Drawn

"B" section is around 12,500 cubic yards per station; and for a 32-foot section is nearly 20,000 cubic yards per station. To secure this dirt required quite extensive borrow pits and a haul up to 400 or 500 feet.

On the three contracts were twenty-four Caterpillar "60" tractors; nine Russell elevating graders, of which five are of the new "60" type with power take off, and four are of the old "42" type with axle drive; twenty crawler wagons; sixty 1 1/2-yard Western dump wagons pulled by 4-up mule teams; and about 165 men. Work was being carried on night and day, in two shifts of about 11 hours each. With this organization and equipment, about 11,000 yards a day of dirt was being placed.

All of the crawler wagons except two are of 7-yard capacity. They include six La Plante Choate 7-yard with hydraulically controlled dumping device; three Streich 7-yard; three Smith 7-yard; six Western 7-yard; and two Euclid 5-yard.

The muck ditch on this job is cut by hand on the

basis of task work, the men getting 18 cents a yard for the dirt moved.

For night work, on the Lowrance Bros. & Co. job, light is provided by two Kohler 1500-watt lighting units. Wires are strung along on the ground and lights are mounted conveniently on poles and moved as necessary.

A. F. Stanford and D. A. Long, members of the contracting firm, are on the job, with the former acting as superintendent. The inspector on 11A is Hobart C. Blanchard; on 11B, Glenn E. Oswalt; and on 11C, Joe P. Gray.

Contracts 41B, D and E.—While the method of moving dirt is essentially the same on the work being done by the Coastal Construction Co., draglines are used instead of elevating graders for loading the wagons. Not as much dirt is required for the levee section as on the contracts described above, since this contract is for enlargement and not new construction.

The contractors have five Koehring 1 1/4-yard draglines on the job loading into six Euclid and one Western 5-yard crawler wagons, which are pulled by seven Caterpillar "60" tractors. Work on this contract also is carried on day and night.

Inspectors on these sections are: 41B, Wm. Dunlap; 41D and E, Walter B. McCord.

All the work described in this article is within the Second Field Area of the Memphis Engineer District. Major E. C. Kelton is area engineer, and associate engineer C. L. Baldwin is assistant.



The Old Type of Equipment. At Pecan Point



Line-Up of Modern Equipment on Coastal Contract—7 Caterpillars, 6 Euclid and 1 Western 5-Yard Wagons With Crawlers; a Koehring 1 1/4-Yard Dragline in the Distance

Washing Rapid Sand Filters

Data Resulting From Operation of Detroit Experimental Plant Over a Two-Year Period. Methods of Preventing Shrinkage and Keeping Sand Clean. Cleaning Old Filter Sand

Detroit, Mich., for two years operated an experimental filter plant comprising two complete units, to be used following chemical treatment and mixing chamber processes, which are common to both of the sedimentation and filter units. The water applied to filter No. 1, which was used as a control, came either from a sedimentation basin of constant dimensions, or direct from the mixing chamber through a by-pass flume. Filter No. 2, the variable unit, took water from a sedimentation basin the size of which was varied for the different experiments. The dimensions of both filter units were 4 by 7½ feet by 9 feet, the sand area thus being 30 square feet. They were operated continuously day and night over a two-year period at a constant rate of 160,000,000 gallons per acre per day. During the greater part of this period, three runs were made each day, six hours in length, one on each eight-hour shift. The sand size and the grading were alike in both filters, and the same as that used in the main plant. Effective sand size was 0.55 mm and the uniformity coefficient was 1.35. The sand depth was 27 inches and free board 34 inches.

Soon after starting the investigation, certain experience seemed to call for a special investigation of the matter of filter sand and the cleaning of sand filters. A discussion of this investigation and a statement of the conclusions reached were contained in a paper read before the Central State Section of the American Water Works Assn. by Roberts Hulbert, senior chemist, and Frank W. Herring, assistant civil engineer, of the Department of Water Supply of Detroit, in which a description of the experiments, with tables, diagrams etc., was given at some length by the authors.*

An effort is made in the following article to give in condensed form the more important points brought out in this paper.

Many rapid sand filter plants have shown a phenomenon called sand shrinkage, in which the sand shrinks away from the edges of the beds and also sometimes opens in cracks in the middle of the beds. Within a few months after the Detroit experimental plant had been put into operation, both filter beds began to show sand shrinkage in deep wide cracks along the side walls. When the bed was cleaned, after about six months of operation, it was found that the coating on the sand grains amounted to an average of 7% by weight throughout the total sand depth, and was about 17% in the top ½-inch layer. The coating consisted of a very adherent alumina and clay gelatinous film, dark brown in color and composed

roughly of 50% alumina and 50% matter insoluble in acid, such as clay and silt. This coating is a colloidal, jelly-like substance capable of holding many times its own weight of water, and adheres tenaciously to the sand grains. This coating adds greatly to the volume occupied by the particle without adding materially to its weight; therefore the sand grain with its coating has a much lower specific gravity than the original sand. The specific gravity of the cleaned sand at Detroit was 2.65. A coated grain of sand, with the water absorbed by the coating, would represent about 50% sand and 50% water (by weight) giving a specific gravity of 1.45, which is not much more than half that of the sand alone.

The sand in the experimental filters was cleaned quite thoroughly so that the coating on the top ½-inch layer was only 1.4% instead of the former 17%. The side wall shrinkage disappeared and did not appear again during the remaining 17 months of operation of the plant, the sand being kept clean during the entire period.

This experience suggested that it would be desirable to prevent the sand from accumulating at any time sufficient coating to cause these shrinkage cracks. Additional advantages of clean sand suggested by the authors were that the initial filter loss of head is reduced by ½ foot to 1 foot and the available operating head correspondingly increased; and that the moist coating on most filter sands is putrescible, which is certainly not advantageous. Moreover, clean sand makes a favorable impression on visitors, who are apt to notice and often comment upon a muddy appearing filter bed.

Keeping the sand clean was found possible in the experimental filters by considerable vigorous use of hand appliances, but this did not appear practicable in a full-size operating plant and they experimented to determine whether it were not possible to maintain filter sand clean by the ordinary washing method. They were prepared to accept reduced bacterial efficiency as an undesirable result of this, but considered it of secondary importance in the investigation. They found, however, that bacterial efficiency was not sacrificed by maintaining the sand in a clean condition.

The wash-water facilities of the experimental filters were increased, making possible a washing rate of 43 inches per minute vertical rise, which resulted in a sand expansion of 16.3 inches, or 60% of the thickness of the bed. From the time this high expansion washing was begun the filters never showed any tendency to become muddy, to collect mud-balls, or to show shrinkage cracks. At the conclusion of the two years' experimental operation the top ½-inch layer of sand contained only 1.5% of coating. On the other hand, the authors found that filters which showed wall

* "Studies on the Washing of Rapid Filters," in the November, 1929, issue of the Journal of the American Water Works Assn.

cracks invariably were found to contain a wedge-shaped mound of quite solid mud-like mixture of fine sand, coagulum and clay lying upon the top gravel layer below the place where the crack showed. After a filter had been washed, the sand in settling mounded conspicuously, quite faithfully showing the location of the mud-mound beneath the sand.

Summarizing the conclusions from their investigations of this matter of shrinkage, they found: 1—When the filter sand is heavily coated and mud-mounds are present, shrinkage appears; 2—that a filter composed of heavily coated sand, but with all mud accumulations removed and prevented from reforming by a sufficiently high velocity wash, does not show any shrinkage; 3—that a filter containing slightly coated sand, say 4% by weight, but containing mud-mounds along the walls, shrinks only slightly; and 4—that if the filter sand is composed of very nearly clean sand (2% of coating or less) and all mud-mounds are absent, no shrinkage whatever takes place.

Most descriptions, if not all, of washing of filters express the rate of wash in inches vertical rise per minute. The authors believe that a preferable index would be the expansion of the filters. "The rapidity and completeness with which the entrained dirt is driven out of the sand bed must depend not only upon the rate of upward flow of wash water through it, but also upon the extent to which the sand layer is opened up or expanded; in fact, the latter seems to us the more important factor." The expansion of the sand they think most conveniently expressed as per cent of expansion, or the per cent which the distance above of the original top surface of the sand to which the sand is raised by the wash, is of the original depth of the sand. It was found at Detroit that apparently a 50% expansion, or perhaps somewhat less, was necessary to prevent the accumulation of deposit upon the sand grains. The amount of expansion was found to be a function not alone of the rate of wash water application, but also of the temperature of the applied water and the physical characteristics of the sand grains, such as size, shape and specific gravity. They suggest that it is probable that sands of different characteristics require different degrees of expansion for satisfactory cleaning.

The objection has been sometimes made to higher velocity wash that this carries a considerable or undesirable percentage of the sand out with the wash water. This, however, the authors found was not the case if the sand was kept clean; the reason being that sand with its accumulation of coating, as shown above, has a lower specific gravity than the clean sand and is therefore carried much higher by the wash water than clean sand is. Prior to cleaning the experimental filters, some sand was always swept out of them during washing at a rate of 28 inches per minute vertical rise. "After cleaning the sand, it was perfectly evident that no grains floated up even close to the trough level. Previously, when watching the coated sand float out we had always felt inclined to reduce the rate of wash, but somehow resisted the temptation; but now with the clean sand level remaining well below the trough it was apparent that the wash rate could even be increased considerably without danger of losing any sand."

As to the amount of water required for washing at a 43-inch rate, they used 4% in the experiments, but stated that 2½% would have been sufficient. The wash water usually cleared within 2½ or 3 minutes so that the sand could be seen plainly through it, which was considered satisfactory, but the washing was continued for a uniform operating period of 5 minutes.

For measuring sand expansion, the authors devised three useful implements. The first of these is a block of wood 5 inches square on the end of a ten-foot iron pipe which is graduated in inches. During the washing this is allowed to settle through the suspended sand until the under side of the block comes to rest on the gravel surface. The depth can then be read from the top of the wall to the top of the gravel and, knowing the depth of the filter box, the depth of the gravel surface at that point is known.

The second implement is a graduated rod, the lower end of which is bent into the shape of a hook, on the upturned end of which is a 50 candle power, 6-volt electric bulb. The zero of the graduations on the rod is level with the top surface of the bulb. During a wash, this rod is lowered slowly into the bed until the light of the bulb is just barely obscured by immersion in the suspended sand, thus giving the elevation of this by reading the graduation on the rod. The sand surface can be located with a surprising degree of accuracy, a ⅛ inch vertical lowering by the gage being sufficient to change from evident illumination to complete obscurity.

The third implement is a float with a specific gravity a little greater than one, so that it will sink but will ride upon the surface of the suspended sand. An indicator shows the height of the float, and a previous calculation indicates the height at which the float should stand to give a 50%, 60%, etc. expansion of the sand bed. The filter operator then opens the wash-water valve wide enough to bring the float to this particular elevation and hold it there during the washing. He thus obtains the proper sand expansion without necessarily paying any attention to wash-water temperature, sand characteristics, etc.

The authors in closing this part of their paper stated that it seemed to them that filter sand should be chosen, first, from the standpoint of its suitability as a filtering medium; the question then being decided as to what expansion will be necessary during the wash to keep the bed clean at all times, and a wash system being designed to give this necessary expansion with a proper margin of safety.

CLEANING DIRTY FILTERS

For cleaning a dirty filter the author suggests the use of caustic soda or lye, a known weight of this being spread over the surface of the filters and wash water then being allowed to rise to a height of say 8 inches over the sand, the depth being such as to give a concentration of the solution of about 2%. The lye is then thoroughly mixed with the water and the water drawn down to about 4 inches depth and held there for about 24 hours. It is then drawn down to the level of the sand surface and held here for 24 to 48 hours. The solution is then washed out of the bed by the usual filter wash and the bed drained. This honeycombs the coating. To remove it they recommend using a fire hose with ½-inch nozzle, by the jet from which the surface of the sand is stirred up thoroughly to a depth

of 8 to 12 inches. An area of 1000 square feet can be covered in three hours.

The filter is then washed and drained, this washing bringing to the surface of the bed coated sand from the deeper layers. Another hosing is given, followed by washing and a third hosing, and even more hoseings until the sand is satisfactorily clean. The authors found three hoseings to reduce the coating in the top 6 inches from 12 or 15 per cent to about 5 per cent. (This method was developed by experimenting with the full-size service filters.)

CONCLUSIONS

The authors closed this part of their paper with the following conclusions:

Filter sand bed shrinkage and other attendant filter troubles in the Detroit experimental plant were overcome by removing coating from the sand grains and mud accumulation from the beds.

By washing the filters at a sufficient rate to obtain 50 per cent or more expansion of the sand, coating and shrinkage were prevented permanently.

Filters composed of clean sand were found to give surprisingly good results in the removal of bacteria, and in other respects performed in the most dependable and consistent manner.

A comparatively inexpensive and workable method of cleaning old filter sand within the filter is described, and the results obtained from its use at the Detroit plant are given.

A sand expansion index for the filter wash is urged to supplant rate of wash water rise, which has been the criterion generally employed.

WASHING CHARACTERISTICS OF SAND

A second part of the paper was devoted to a description of the subject of washing characteristics of filter sand. The authors concluded that the expansion due to wash water is independent of the amount of free-board or lift above the sand; but that it depends for its value upon the rate of flow of the wash water, the temperature of the water, and upon the size of the sand grains; as the rate of wash increases, the expansion increases; as the temperature and size of sand grains increase, the expansion decreases. Within the limits of accuracy of determining the values of the several factors involved, the rate of wash necessary to bring about the desired degree of expansion can be represented by the formula.

$$r = [1.04 + 0.01 (t - 32)] (s - 0.17) e + \frac{5.9}{1 - (s - 0.17)} + 0.24s (t - 32) - 7.4$$

where

r = rate of application of wash water, expressed in inches per minute.

e = resultant expansion, expressed as per cent of original depth.
 t = temperature of water in degrees Fahrenheit.
 s = diameter of grain such that 30 per cent of the sample, by weight, is finer.

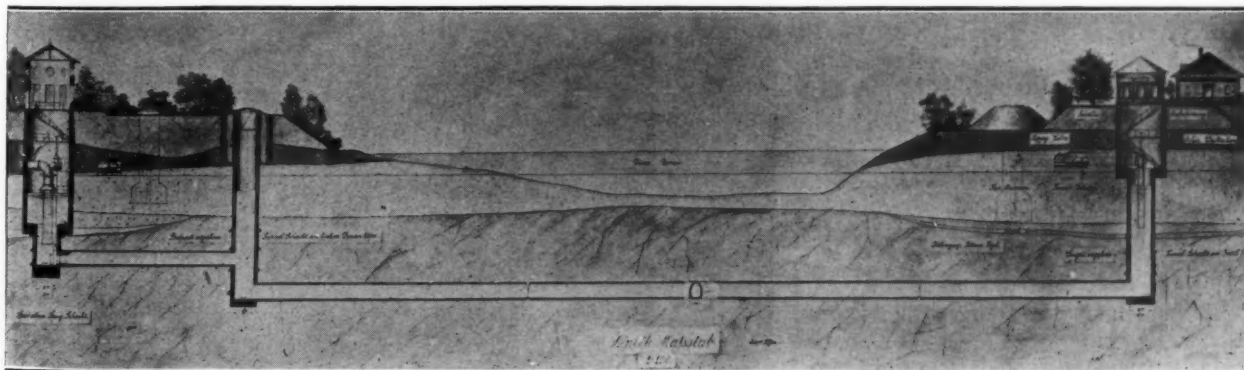
DISCUSSION OF THE PAPER

This paper was discussed by thirteen engineers and chemists, who expressed their appreciation of the importance of it, but several of whom differed from certain of the opinions presented by the authors. Some thought the conclusions might apply only to the particular water and sand used in Detroit, although, as John R. Baylis said, if the increased rate of wash "will work satisfactorily or result in an improvement in a number of plants it will be a distinct advancement in the solution of filter bed troubles." Mr. Baylis, in an experimental plant at Chicago, agitates the surface sand in the bed by water jets from perforated pipes under about 30 pounds pressure for two or three minutes before beginning the wash. In some cases high wash-water rate has disturbed the gravel and allowed the sand to enter it.

Wynkoop Kiersted remarked that this paper "displays all ideas that there is such a thing as a 'ripened' or 'seasoned' rapid filter, and is also one of the strongest proofs of the assertion made by the writer that rapid filtration should be considered as purely a straining process, dependent for its efficiency upon the coagulum that forms upon the sand and around the sand grains in the upper portion of the sand bed;" and Abel Wolman and Sheppard T. Powell agree with this idea. On the other hand, Myron G. Mansfield said that it is "at variance with findings at other places, thus illustrating the caution with which these particular results should be used."

W. C. Lawrence stated that, applying the authors' formula, a 50 per cent expansion could be obtained with a 24-inch rise of wash water if the sand be of 0.40 mm. effective size and the temperature 32° F., while the same rise would give only 25 per cent expansion with water at 73°. At Cleveland he had lengthened filter runs 36% and saved 16% wash water by securing a 50% sand expansion. J. F. Laboon cited a plant using Lake Erie water where mud balls formed with a 24-inch rise, but when the rise was increased to 36 inches as regular practice formation of mud ball ceased.

Wm. Gore told of experience of Ottawa, Canada, where washing was found to be sluggish in the corners and along the sides of the filters, and they increased the amount of washing at these places. Mr. Mansfield said that Cambridge, Mass., successfully eliminated mud balls by weekly rakings by hand.



Part of the Waterworks Supplying the City of Budapest, Capital of Hungary—Three Tunnels Under the River Danube Deliver Water From Island Shafts to the Left Bank of the Stream



Clearing the Right-of-Way With a Caterpillar

Construction Methods on the Hornell-Canisteo Section of Route 17

Hard shale and sandstone excavated by shovel without blasting. Study of delays in mixing time gives valuable data.

Advanced methods and modern machinery were much in evidence in the construction of a section of concrete highway on Route 17 between Canisteo and Hornell, N. Y. The contract, which was awarded to W. L. Collins, Hornell, for \$198,185, involved the construction of 3.91 miles of concrete highway along the Canisteo river, and 40,000 cubic yards of unclassified excavation, of which a large part was rock. The pavement was laid in two lanes, each 10 feet wide, and the contract called for grading and drainage structures for another 10-foot lane, the third lane of pavement to be constructed when the traffic requires it. The riverside shoulder of the road is of earth, 4 feet wide, while the land side is 15 feet 6 inches wide, graded to form an extra driveway or parking space. The pavement is of the standard mesh-reinforced type, 8 inches thick at the edges and 7 inches in the center.

GRADING AND EXCAVATION

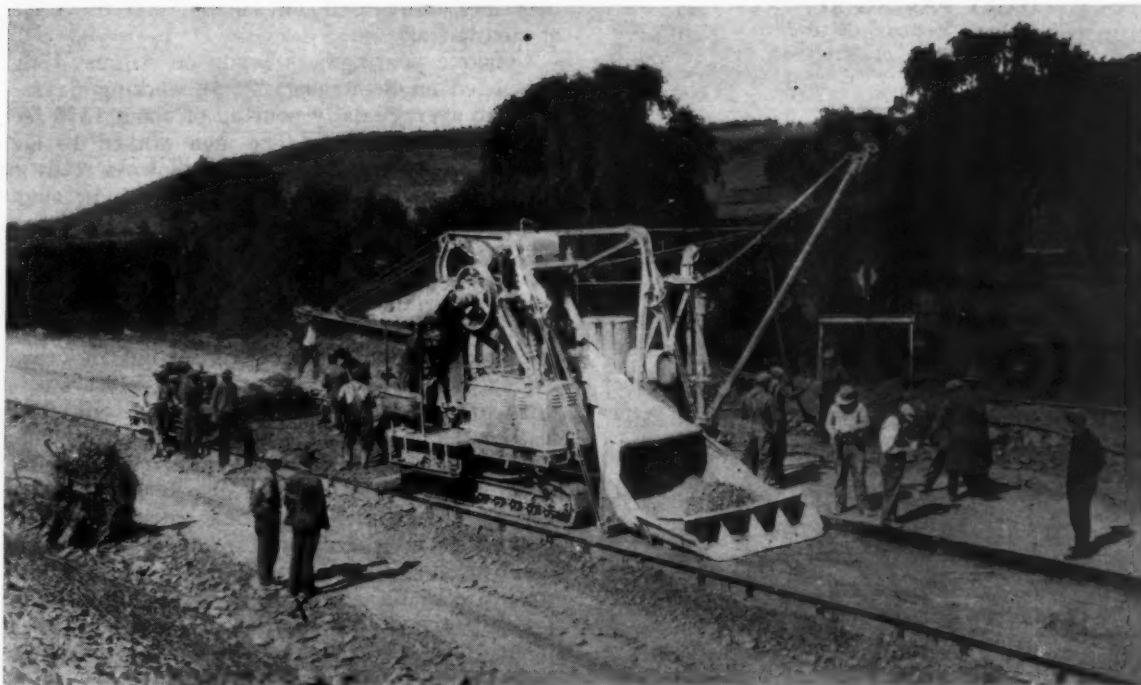
The methods of handling the excavation are of interest. There was 26,000 cubic yards of hard shale and sandstone. This was handled practically without blasting (less than 50 cubic yards re-

quired the use of powder) by means of a $\frac{3}{4}$ -yard Bucyrus-Erie steam shovel, which was purchased new for the work. The entire 26,000 cubic yards was handled without delay or without any repairs to the shovel. Another Bucyrus-Erie 1-yard steam shovel was used on other portions of the work.

Clearing was necessary on some of the contract where new location was chosen to eliminate excessive curva-



An Erie Steam Shovel Digs Through the Rock



Koehring Mixer and Ord Finisher at Work

ture in the old road, which in places followed along the cliffs some distance back from the river. A Caterpillar "30" tractor pulled stumps and dragged logs and loose rock off the right-of-way. The clearing gang was followed by the shovel, which loaded into motor trucks for hauling to the fill. Because of the rather cramped quarters, 3½-ton International Harvester Company motor trucks were used principally, their short wheel-base facilitating turning and handling; but a Blaw-Knox turntable at the shovel, used later at the mixer, paid for itself in saved time every week, according to the contractor.

The grading of the extra lane was accomplished chiefly by the use of the Adams grader drawn by the Caterpillar tractor. Where needed, extra dirt was hauled in with the trucks, and after the heavy grader had smoothed this out, a small 2-horse grader was used to give another dressing, after which the shoulder gang gave the final treatment.

The new location involved several fills which in places had a depth of 10 feet. In order to eliminate settling of the fill and cracking of the pavement, or the alternative of waiting for the fill to settle before placing the pavement, the fills were built up in 2-foot layers and rolled thoroughly. An Adams leaning-wheel grader, pulled by a Caterpillar "30," was used for smoothing out the fill and leveling the material. By this method of construction, a compact embankment was secured which, it is thought, will not settle enough to cause any difficulty. Pavement was placed on these fills without delay.

BRIDGES AND CULVERTS

There are no large bridges on the contract. Small culverts are of cast iron and there are also several 3 ft. x 3 ft. concrete box culverts. All culverts were trenched out by the steam shovels, and the shovels were used also to handle the pipe into place. American Casting Co. (Dan Dimick's) pipe was used for the cast-iron culverts.

THE PAVEMENT

Local sand and stone, secured from material supply firms at Hornell, were used. The mix was 1:2:3½, with Standard portland cement and Wickwire-Spencer reinforcement. Carey Elastite expansion joints were spaced 78.5 feet apart.

The subgrade was previously brought to approximate grade and section by means of the Adams grader pulled by the Caterpillar "30" tractor. The fine grading gang consisted of about 11 men, who were equipped with a Buffalo-Springfield 5-ton gas roller, and also a Lakewood grade rooter. Following this gang was the form placing gang, consisting usually of 8 men, placing, re-



Bucyrus-Erie Shovel on Grading

DAILY PAVING REPORT

Mixer Started 7:00 A. M.

	From	To	Cause
7 to 8 A. M.			
No. Batches	7:00	7:10	No water
36			
No. feet			
156			
8 to 9 A. M.			
No. batches	8:40	8:44	No batches
36			
No. feet			
156			
9 to 10 A. M.			
No. batches	9:20	9:23	No water
36			
No. feet			
156			
10 to 11 A. M.			
No. batches	10:30	10:35	No water
36			
No. feet			
156			
11 A. M. to Noon			
No. batches	11:00	11:08	No batches
26			
No. feet			
108			

Mixer Started 12:54 P. M.

	From	To	Cause
1 to 2 P. M.			
No. Batches	1:01	1:05	No batches
35			
No. feet			
126			
2 to 3 P. M.			
No. batches	2:20	2:22	No batches
36			Changing time device on mixer
No. feet	3:00	4:00	No batches
156			A total of 14 min. lost between 3:00 and 4:00 and one-half min. at a time waiting for water.
36			
No. feet			
156			
4 to 5 P. M.			
No. batches	8 min. between 4:00 and 5:00 for same reason.		
36			
No. feet			
156			
5 to 6 P. M.			
No. batches	5:16	5:20	No batches
39	5:30	5:32	No gas in mixer
No. feet			
164			

Total for the Day

Total No. feet laid.....	1490
Total cubic yards laid.....	344.9
No. barrels cement used.....	598.5

Factor 1.735

Duration and Causes of Delays

Delays	Cause
36 min.	No water
25 min.	No batches
2 min.	Mixer out of gas
2 min.	Changing timing device on mixer
1 hr. 5 min.	Total lost time.

moving and moving the forms. These men kept 800 to 1,000 feet ahead of the mixer. Both Blaw-Knox forms and Abernethy adjustable forms were used on this contract.

A Koehring 27E paver was used, followed by an Ord double screed finisher. The mixing and finishing gang consisted of 12 men, as follows: 1 foreman, 1 operator, 2 men operating the skip crane, 4 men in the mud and 4 men on reinforcing, patching and doing other work. After the initial set, burlap, and

then hay, were used for curing, and the road was opened to traffic in 15 days.

Concrete pouring was begun on August 17th, and completed on September 27, 31 working days. This gave an average daily pouring of about 1350 feet, including all lost time. The men worked 10 hours a day, and no more. Herewith is shown a study covering the working day of August 21, indicating time lost during each hour of that day, and the reason for the loss. These studies were continued throughout the period that laying was carried on, and resulted in exceedingly valuable information regarding this important factor in construction.

Sand and stone were delivered by truck by local firms to a Blaw-Knox batching plant, which was loaded from the stock piles with an Erie crane equipped with a Blaw-Knox clamshell bucket of $\frac{3}{4}$ -yard capacity. Aggregate was handled to the mixer in 54-cu. ft. steel batch boxes made by the Cold Spring Construction Company, Akron, N. Y. These batch boxes were carried on platform body trucks, which were run under the batcher for loading. At the mixer, these boxes were picked up with a small crane and dumped into the skip, then being returned to the truck.

At first, cement was added to the aggregate in the batch boxes at the central plant, but later, in accordance with the requirements of the department that it be brought to the job in the original containers, it was hauled to the mixer by truck and emptied into the skip directly from the bags; which method worked out very well.

Water for the supply was secured from the Hornell and Canisteo supplies, and was carried through lines of two miles each of 2-inch and 2½-inch pipe to the job. Hose connections were 140 feet apart, and the mixer hose 100 feet long. A Barnes triplex pump of 70 gallons per minute was used as standby and for boosting purposes.

Traffic was handled by means of the flag system. There was little difficulty or delay, due, in part, to the extra lane graded for future paving, in part because of the lack of heavy traffic, and also because a portion of the road was in new location, thus allowing traffic to use the old road.

Most of the labor was secured locally. A camp was provided, but was used only by a part of the men. From 70 to 75 usually were employed on the job.

William L. Collins, the contractor, was in general charge of the work, and Don. L. Scott was superintendent. Stanley Sibley was resident engineer for the State, under O. J. Dempster, district engineer, and Gordon Edson, construction engineer.



Compacting the Fill With a Roller

Boulevard Construction in San Francisco

Principles and Plans Followed in Designing and Constructing Boulevards

For a number of years the city of San Francisco has been carrying out quite an ambitious program of boulevards, spending several million dollars a year on the work. The general principles and plans followed in designing and constructing these boulevards is described as follows by M. M. O'Shaughnessy, city engineer:

In all boulevard construction, permanent paving is laid immediately where the subgrade is in a satisfactorily compacted condition. On fills or other places liable to settlement, a temporary pavement is laid. This consists of water-bound macadam 8 in. thick with wearing surface of either asphaltic concrete, oiled macadam or emulsified asphalt. The grade of the finished temporary pavement is so fixed that the macadam will serve as a foundation for the concrete base of the permanent pavement, which will be laid when the fill shall have become thoroughly compacted after a season or more of weathering.

Permanent paving on all the boulevards, except the Great Highway, consists of 8 in. of concrete base, 1½ in. of asphaltic binder, and 1½ in. of asphaltic concrete wearing surface. On the Great Highway, which is used almost entirely by pleasure vehicles, the pavement consists of a 10-in. macadam base with a 2-in. asphaltic concrete wearing surface.

For concrete base, the mix is approximately 1 part of cement to 5.5 parts of aggregate. Specifications require 6 sacks of cement per cubic yard of concrete, with sufficient water to produce a slump of 1½ in. Aggregate generally runs 1 part of fine to 2 of coarse.

The specifications provide that concrete that is to be hand finished shall be poured in 10-ft. strips, but that if mechanical spreaders be used, the contractor may pour strips 20 ft. wide. All concrete work in progress is being spread and finished by a machine mounted on header boards and with a strike-off plate shaped to the crown of the roadway. Contraction is provided for by weakened planes or dummy joints ¼-in. wide and 2 in. deep, spaced in the concrete at 25-ft. intervals, filled with asphalt to within ½ in. of the surface.

Curing was done on some of the earlier work by water and diking, but on all the later work it has been considered advisable to use an asphalt spray coat. A very thin coat of asphaltic cement is sprayed on the cured concrete prior to the placing of the binder course. Close attention on the part of the inspectors results in concrete showing a 7-day test of about 3000 lbs. and a 28-day test of about 4200 lbs.

The asphaltic binder is composed as follows (by weight): Asphaltic cement, 4% to 6%; stone dust, 4% to 6%; sand, 20% to 35%; coarse aggregate, 72% to 53%.

The asphaltic concrete wearing surface consists (by weight) of: Asphaltic cement, 6% to 8%; mineral aggregate, consisting of broken stone or gravel, sand, and stone dust, 94% to 92%.

Both binder and wearing surface are spread with a mechanical spreader with a raking attachment. Roll-



Pedestrian Subway on the "Great Highway"

ing is done with a 3-wheeled 12-ton roller followed by an 8-ton tandem roller. The finished surface must be true and uniform, with no rolls or depressions in any 10 ft. exceeding ¼ in. from the true grade and cross section of the finished strip.

Conduits for lighting standards and traffic signals, and public utility pipes and ducts are being laid now to avoid tearing up the pavement in the future. The type of lighting standards to be used has brought forth much discussion. The Board of Supervisors' Street Committee has not agreed to the selection of the standard made by the city engineer and has been striving to secure control of this portion of the boulevard work. In the meantime, the construction of boulevards is progressing and some sections will be opened to traffic without street lights.

Georgia to Prequalify Bidders

The State Highway Board of Georgia on November 22 passed a resolution "that notice be given contractors by letter and through the press that they must qualify before being permitted to receive plans for preparing and submitting bids by filling out an approved questionnaire and furnishing any other information requested." Also "that the state highway engineer, the head of the accounting department, and the chairman of the State Highway Board be named as a committee to investigate the ability of the contractors and report to the State Highway Board; and if said contractors meet with the requirements of the State Highway Board, their names are to be put on an eligible list. If a contractor who submits a bid does not appear on the eligible list, his bid is to be returned to him at the time of the letting without being opened. Any bid that is opened must be given consideration."

Winter Sport in the Southwest

The New Mexico Highway Department has recently purchased truck driven snowplows for use in the Sacramento Mountain region. This region is rapidly becoming a nationally known playground with several thousand cottages now owned by residents of states other than New Mexico in the timbered regions. The installation of the snowplows in this section will add greatly in keeping the playground sections open during the winter months for the convenience of the ever-growing number of winter sports enthusiasts who flock to the hills.

Gas Pressure Bursts Sludge Pump

The casing of an 8-in. pump, which was filled with sludge, burst due to gas generated by the sludge. Laboratory tests indicate that sludge kept in sealed containers will produce pressures as high as 1400 lb. per sq. in.

By C. E. Keefer*

The Baltimore sewage works is provided with a number of sludge pumps, some of which have been in service since 1912. These units vary in size from 6 to 10 in., with capacities ranging from 1000 to 2800 gallons per minute, and are used to pump raw and digested sludge. On September 27, 1928, one of these pumps, an 8-in. vertical "Wood" unit, exploded. The pump had been in operation a few days previous, and when it was shut down it was filled with sludge, as were the suction and the discharge pipes. Due to the arrangement of the piping, it was always necessary during the sixteen years that the unit had been in

During the first two tests the temperature of the sludge was not carefully controlled, but varied from 59° to 80° F. during the first test, and from 57° to 86° F. during the second. In each instance the average temperature was usually well above 70° F. During the third test the sludge was kept in an incubator at 83° \pm 1° F.

The pressures generated are shown in Fig. 2. During each trial the pressures exceeded 1200 lb. per square inch, and reached a maximum of 1425 lb. per square inch during the second test. These high pressures were obtained very rapidly during the first and

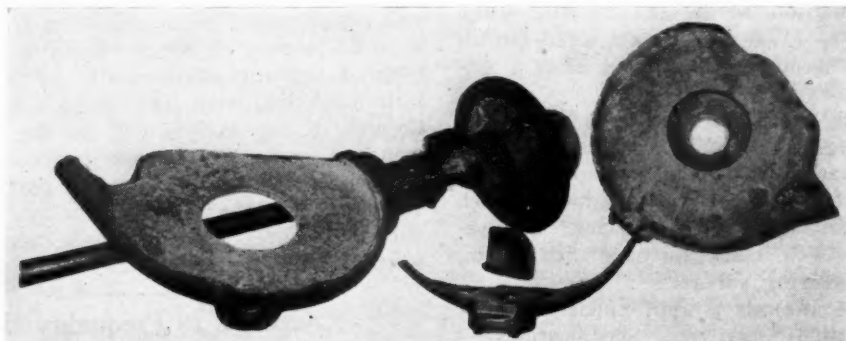


Fig. 1. Damaged 8-Inch Sludge Pump at Back River Works, Baltimore

service to shut the valves on both the suction and discharge sides of the pump. The sludge in the unit was, therefore, always trapped.

Roughly speaking, the casing of the pump burst along a plane perpendicular to the vertical shaft, as indicated in Fig. 1. An inspection was made of the casing, which consisted of cast iron, one inch thick, but no flaws or imperfections in the metal were apparent. On the assumption that the cast iron could withstand a stress of 20,000 lb. per square inch, a pressure of 1900 lb. per square inch in the sludge would have been required to rupture the unit.

It was thought at first that perhaps the impeller had become unscrewed from the shaft due to a reversal of the current used to run the motor. An examination of the pump, however, showed that the damage was due to some other cause.

The only other apparent reason for the bursting of the unit was excessive gas pressures produced by the decomposition of the sludge in the pump. In order to see what pressures would be produced by sludge inclosed in a sealed container, several laboratory-controlled tests were made. A steel cylinder with a capacity of 116 cu. cm. was prepared, to which was attached a hydraulic gauge. As indicated in the accompanying table, the cylinder was filled with different mixtures of raw and partly digested sludge.

second trial and much more slowly during the last. As the container was filled with sludge at the beginning of each test, at least some of the gas formed went into solution. None of the sludges at the end of the experiment were fully digested, although it is believed that they would have been if the pressure had been normal. The supposition is that digestion progressed to a certain point, and then stopped due to the high pressures.

The experiment indicates that the bursting of the sludge pump was very likely due to high gas pressures. The experience at Baltimore indicates that sludge pumps or the adjacent piping should either be equipped with relief pressure valves, or the installation should be designed so that gas, produced from decomposing sludge, can escape. The danger is greatest where partly or fully digested materials, which usually contain gas, are handled; but even where raw sludge is pumped, there is a possibility that the material may be allowed to remain in the unit sufficiently long for decomposition to commence and gas to form. This latter condition is more likely to occur where the pumping unit is in a heated building. The engineer should not prepare his designs on the assumption that the operator will drain the pump after each period of pumping, as the latter may fail to perform this operation, and trouble may result.

The practice at the Baltimore plant is generally never to drain the sludge pipes, of which there are

*Engineer of Sewage Disposal, Bureau of Sewers, Baltimore, Md.

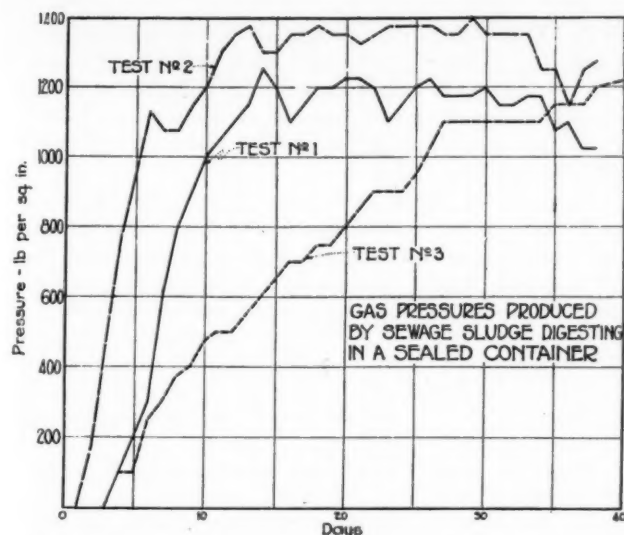


Fig. 2—Pressures Generated in Sealed Test Cylinder by Decomposition of Sludge

several thousand feet. There is a hazard, therefore, that gas from decomposing sludge may form in the pipes and cause an explosion. In order to prevent this condition, pressure relief valves have been installed on the pipe lines at frequent intervals.

C. F. Goob is chief engineer of the Department of Public Works. The sewage works is under the general supervision of M. J. Ruark, sewerage engineer, and G. K. Armeling is superintendent of the plant.

Character of Sludge Digested Under Pressure in Steel Container.

	TEST NUMBER		
	1	2	3
Character of Materials At Beginning of Experiment			
RAW SLUDGE—			
Volatile matter	84.1%	68.3%	81.6%
Moisture	90.6	96.5	92.1
Ether soluble matter..	...	14.3	42.9
pH	5.0	6.7	4.9
SEEDING SLUDGE—			
Volatile matter	55.3%	60.8%	57.1%
Moisture	92.7	92.1	93.1
Ether soluble matter..	...	15.1	12.3
pH	7.2	7.0	7.3
Ratio of raw to seed- ing material	1:1	14:3	2:1
Bacteria in mixture—			
Total count per gram	..	...	350,000,000
Acid formers per gr.	..	...	10,000,000
Incubation tempera- ture, degrees Fahr. .	59.80	57.86	83±1
Character of Materials At End of Experiment			
Volatile matter	59.8	62.4	63.5
Moisture	95.6	97.4	92.6
Ether soluble matter..	17.0	15.6	20.2
pH	7.0	7.0	6.9
Bacteria			
Total amt. per gram	..	..	100,000
Acid formers .....	..	..	0
	lbs.	lbs.	lbs.
Maximum pressure de- veloped per sq. inch	1250	1425	1300

Build and Be Gone in Pennsylvania

The following discussion of Mr. Taylor's article has been received from H. E. Moses, assistant chief engineer of the Pennsylvania Department of Health:

Mr. Taylor's experience as related in the first paragraph of his article is one that is not unique. Too frequently sewage disposal plants, especially the smaller ones, are operated with a minimum of attention and naturally they fall into disrepair and oftentimes disrepute in the neighborhood.

In many cases these plants have been built to satisfy the requirements of a State Health Department or to avoid damages to a down stream community or lower riparian owners and after they are constructed then the town proceeds to forget about them and the natural result follows.

As compared with municipal light plants or a municipal waterworks, the sewage treatment works is not a dividend producer and very often there is not the same willingness to appropriate funds for operation and maintenance while at the same time there is perhaps just as much reason for skilled operation as in the case of the other two plants.

Realizing this situation, some of the State Health Departments have endeavored to assure the satisfactory operation of plants by providing for skilled operation or, at the very least, competent supervision for a period of time after the works are placed in operation. One state issues licenses to sewage plant operators; another one requires sufficient money to be in sight before the plant is built to insure competent operating personnel thereafter. In several states attention is being given to the matter of an annual sewer rental in order to provide funds, among other things, for plant operation.

In Pennsylvania an endeavor has been made in several directions to meet this situation. First of all a proper design of the plant is insisted upon, to the end that when built it may function with a minimum of trouble. Secondly, in issuing the permit approving the design, conditions are written into this document requiring the plant to be maintained in proper condition so as to perform the function for which it was designed and stipulating that records of operation shall be kept and sufficient tests made for the proper control of the operation. Finally, expert engineering supervision is required for a given period after the plant is put in operation, as may be noted from the following standard stipulation written into such permits:

The sewage treatment works shall be operated by a competent person or persons, and in this connection attention is directed to the necessity for expert advice and supervision over the operation of the sewage treatment works in order to secure efficiency of operation and protection to the waters of the State. To this end the (.... name of municipality....) shall place the operation of the sewage treatment works under the control of the designers of the plant or some other person equally expert in the operation of sewage treatment works for at least one year after completion thereof.

The above procedure relates as well to water filtration plants. However, it has been the writer's experience that such plants are likely to be better cared for and more efficiently operated than the average sewage plant. The public demands a good water supply and usually knows very little about the treatment of the town's sewage.

After all of the foregoing steps have been taken, the Health Department's engineers may make frequent inspection of these plants to observe their condition and to advise with the operators as to the best methods to be adopted to secure the desired results. Satisfactory cooperation along this line is productive of much good.

It might be well for the designing engineer to provide for the comfort of the operator. Without the expenditure of much money a few small additions could be made to the plant which would mean much in promoting a better attitude of mind in the operator than when he is to work under disadvantages. The writer just recently inspected a plant where some attention has been given to beautifying the surroundings and touches were added here and there to lighten the labors of the operators, with facilities for their comfort; the result of which was reflected in the cheerfulness of the operators and their evident attempt to have the plant present a good appearance.

Water and Sewerage Work in Iowa in 1929

The following data concerning water purification and sewage treatment plants built in Iowa in 1929, were furnished through the courtesy of A. H. Wieters, chief engineer of the Iowa State Department of Health.

During the 1929 sewage disposal plants consisting of Imhoff tanks, trickling filters and sludge beds were constructed at Remsen, population 1,203; at Lake City, population 2,211; at Aplington, population 682; at Greene, population 1,299; at Independence for the Independence State Hospital; and a plant consisting of Imhoff tank and sludge beds at Portsmouth with a population of 334.

New sewer systems were built (not including extensions to old plants) at Aplington, Greene, and Portsmouth.

New water works plants were constructed as follows: Deep well and water works systems at Hornick, population 311; at Pisgah population, 375; at Mondamin, population 451; at Irwin, population 316; and at Mt. Pleasant, population 4,445, for Mt. Pleasant State Hospital.

Iron removal plants were constructed in the state as follows: Aerator and settling basin and gravity rapid sand filters at Onawa, population 2,043; at Webster City, population 6,649; at Pleasantville, population 872, an iron removal plant consisted of aerators and settling basin only. At Postville, population 1,030, an iron removal and softening plant was built consisting of aerators, coagulation and settling tank and gravity filter. At Cedar Rapids, population, 50,561, a new plant was built for filtering and softening Cedar river water, the old plant to be junked. The new plant consists of low-service station, Dorr clarifiers, four 3,000,000-gallon rapid gravity sand filter units with all necessary appurtenances for excess lime softening, including recarbonation. At Fort Dodge, population 21,702, a filter plant was built for iron removal consisting of Dorr clarifiers and rapid sand gravity filters; the design providing also basins for recarbonation, necessary mixing tanks, chemical storage, etc., for a softening plant to be installed at a later date. Iowa City, population 15,289, built a water filtration plant consisting of Dorr clarifiers and rapid sand gravity filters for the State University. Here, also, necessary basins, chemical storage and chemical mixing tanks have been provided for converting the plant into a softening plant at a later date.

Illinois Sanitary Water Board

A board by this name was created by the Illinois Legislature in 1929 and went into operation in July of that year, the duty and power of which are "to control, prevent and abate pollution of streams, lakes, ponds and other surface and underground waters in the state." This board consists of the directors of the Departments of Public Health, Agriculture, Conservation, and Purchases and Construction, respectively, and a representative of the manufacturing interests of the state, the last to be appointed by the governor. The act also provides that the chief sanitary engineer of the Department of Public Health shall act as the

technical secretary of this board. None of these receives any compensation other than that already paid him by the state in his capacity as director, and the travelling expenses are paid out of the regular travelling appropriations made to the respective departments.

The duty of the board is more specifically described as being "to study, investigate, and from time to time determine ways and means of eliminating from the streams and waters of the state, so far as practicable, all substances and materials which pollute, or tend to pollute, the same and to determine methods, so far as practicable, of preventing pollution that is detrimental to the public health, or to the health of animals, fish or aquatic life, or detrimental to the practicable use of the water for recreational purposes."

Pollution is defined as that which results from any discharge of any liquid or solid substance which impairs said waters, after reasonable treatment, for public water supply, bathing or recreational purposes, if said water was reasonably capable for such purposes previous to such discharge; or if obnoxious odors result near buildings, roads and lands occupied or used by human beings; or if the water is impaired for the use of live stock or is injurious to fish life.

No sewerage system can be constructed or added to or changed without a written permit from this board except such as receive sanitary sewage from a building occupied by 15 persons or less.

If the board finds any case of pollution, it is to serve a notice on the offending party, directing him to appear at a public hearing, where evidence is to be taken with reference to said matter; after which it may issue an order requiring the discontinuance of such pollution. If the pollution is not abated voluntarily, action may be commenced and maintained by the attorney general in the name of the people of the state for abatement of the nuisance. Failure to obey any of the orders of the board is punishable by a fine of \$100 for each day's continuance of the violation, the penalties to be recoverable upon suit of the attorney general as debts are recoverable at law.

This act does not apply to "any existing sanitary district which now has a human population of one million or more within its territorial limits." (This we understand, applies only to the Sanitary District of Chicago.)

The present members of the board are Andy Hall, director of Public Health, Ralph F. Bradford, of Conservation, Clarence F. Buck, of Agriculture, Harry H. Kohn, of Purchases and Construction, and Clarence J. White, a manufacturer. The secretary is Harry F. Ferguson.

Road Letting in New Mexico

The New Mexico Highway Department on February 12th, will let contracts for the construction of roads which will cost over one and quarter million dollars. Most of these are being constructed to close gaps in the major highways. Five of the projects will be in what is said to be America's oldest road, running from Raton, N. M., to El Paso, Tex. The other projects will close the last gap between Roswell and Clovis, and between Des Moines and Grenville on U. S. 385, which is a feeder road into northern New Mexico from Dalhart, Texas.

Concrete Bridge Construction

In Walla Walla County

By Edward R. Smith*

While many counties use standard bridge sheets supplied by state highway departments or employ private firms to plan the larger structures, Walla Walla county in Washington replaces its antiquated bridges with new ones designed by and built under the supervision of the county engineer. Reinforced concrete is used, as the bridge once finished is doomed to perpetual neglect by reason of the paucity of maintenance money. Standard practices of determining stresses, of water control, of grading aggregates, and of contract work are employed.

Elements controlling the design of a particular crossing include the location, foundation, stream, grade of highway, type of road and traffic, price of materials at the site, the supply of labor, and the haul

bread work should be held down. The size of pouring should fit the type of machinery available. Steel rods must not protrude in any length from a finished pouring to interfere with the form work for the next. Similar dimensions and multiple units should be used throughout the structure to facilitate the placing of forms and their repeated use. The economical type, evolved for the larger streams, is a semi-rigid T-beam multiple-span bridge, having a center span with fixed ends, and with the remaining spans fixed at but one end and with one end provided with bronze sliding plates.

Dimensions should fit the form material commonly used. To help in the rapid placing of steel, bars on the plans should be numbered, not lettered, and a color



Wickersham Bridge, Showing Special Rail

from the nearest railway siding. If the site be near a source of sand and gravel, a larger amount of low-strength concrete may be used with the steel cut down. Where the cost of aggregates is high, as in mountain road crossings, a high strength concrete with the maximum steel is used.

There are many factors in the design of a structure which will cut down the cost, no matter where the site be located. The design should expedite the cutting and placing of form work. Skews, curves, and ginger-

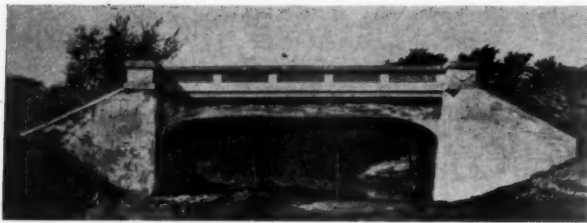
bread work should be used by the mill supplying the steel. The numbering should start with the foundation work, with the highest numbered steel in the superstructure.

Low, thin bulkheads set into the stream to catch the fill from the end of the bridge are cheaper than thick, high abutments and wings. By using a heavy flange or coping on the outside of a solid handrail, the thickness of the rail web and that of the curb and floor can be cut down, with a reduction in the overhanging weight at the sides of the bridge and a closer spacing

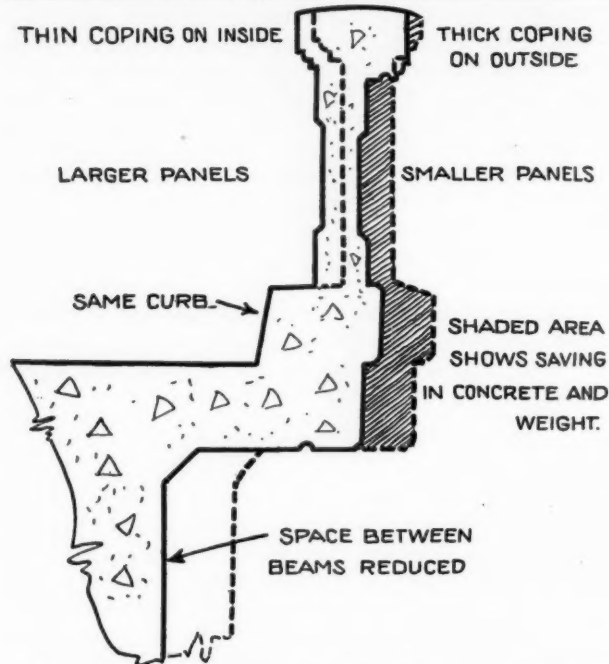
*County Engineer, Walla Walla Co., Washington



The Whitman Bridge. Multiple-Span Design Having Eight Separate Points of Excavation Requiring Sheetpiling and Pumping, 176 Feet in Length With a Twenty-Foot Roadway, Built at a Cost of \$12,600, Which Figure Includes Approach Fills



Whetstone Bridge, Showing Special Rail



Sketch Showing Saving in Concrete in Special Rail

DETAILED BID SHEET

Johnson Bridge

(This sheet may be detached by bidder before submitting bid)

Excavation, Structure	375 cu. yds @	
Excavation, Common	5420 cu. yds @	
Common Borrow	2300 cu. yds @	
Excavation, Solid Rock	135 cu. yds @	
Gravel Surfacing	260 cu. yds @	
Overhaul - yard stations	560 cu. yds @	
Cement, F.O.B. cars at Touchet	600 bbls @ \$3.96	
Sand, F.O.B. cars at Touchet	173 cu. yds @ \$1.95	
Gravel, F.O.B. cars at Touchet	260 cu. yds @ \$2.28	
Steel Reinforcing Bars	45000 lbs @	
Form Lumber		
Cartage on Material Touchet to Bridge Site 7 Miles		
Bronze Plates & Expansion and 2 Name		
Tamtex or Waterproof Paint	650 lbs @	
Stucco	20 lbs @	
Glass for panels	20 lbs @	
Iron Pipe & drains in deck & in Piers		
Asphaltic Expansion Material 1/2" 100 sq. ft.		
Formwork and Wiring labor		
Pouring labor		
Form Removal labor		
Finishing labor		
Painting labor		
Insurance and Medical Aid		
Total		
Bond and Profit		
Amount bid		

OFFICIAL DOPE SHEET

Information About Permanent Highway No. 30A, Walla Walla County, Washington

CALL FOR BIDS. At 10 A. M. Friday, March 18th, the Board of County Commissioners of Walla Walla County will open bids on a contract to grade and surface with two-course crushed rock 5.93 miles of Permanent Highway No. 30A, known as the Sudbury-Shaw Road. The proposed highway begins at the end of the present surfacing fourteen miles northwest of Walla Walla, near the Northern Pacific siding at Rulo and parallels the railway to a point 1000 feet north of Paddock Siding. The steepest grade is 4.3 per cent.

CLASSIFICATION. Test pits and railway cuts show no solid rock or hard pan, so all excavation is classified as common. Soil is light and dry.

QUANTITIES. Over 10,000 yards is side borrow from ditches. Some 3000 yards must be hauled over a thousand feet, making up most of the item of overhaul. Cross sections have been taken every 25 feet over the entire six miles and quantities checked and rechecked. A mass diagram was used in figuring overhaul and breaking points.

ABOUT ROCK. There is a free quarry site at the north end of the project. The rock is "dice" basalt, brittle, and easily broken up. In similar rock two small Aurora No. 2 jaw crushers, one being used for a recrush, have turned out 240 yards in a nine-hour day. The rock will shoot up in chunks smaller than a man's head. There are no "nigger-heads" and no water pockets. The site is one mile to the nearest available water.

CONCRETE. The Class "C" concrete listed is in pipe headers.

WATER. There are three wells along the proposed improvement, one at each end and one near the center. The usual price for water is 20 cents per hundred gallons.

DATE OF COMPLETION. The date of completion is set at September 30th, 1927. Plans were approved by the State Highway Department March 1st and the call for bids officially advertised in the Walla Walla Times of February 28th, March 4th, and March 11th. Specifications are Washington State Standard and are Lowman-Hanford print. Plans are on file in the office of County Engineer, Walla Walla, and at the offices of the Associated General Contractors, Spokane, Portland, and Seattle, and at the office of the Associated Industries, Tacoma. A deposit of \$5.00 is required to insure the safe return of the plans on or before the time of opening bids.

The larger quantities include:

Excavation, Common	56,354 cu. yds.	Concrete Class "C"	38,992 yds.
Excavation, Ditch Borrow	10,360 cu. yds.	Timber	\$480. F. B. M.
Excavation, Pit Borrow	287 cu. yds.	12" Plain Conc. Pipe	21 lin. ft.
Excavation, Pipe	179 cu. yds.	18" Reinf. Conc. Pipe	651 lin. ft.
Overhaul yard stations	40,210 cu. yds.	30" Reinf. Conc. Pipe	25 lin. ft.
Surfacing, 2 Course	11,485 cu. yds.	Finishing	91800 lin. ft.

THE BOARD of County Commissioners of Walla Walla County is made up of N. B. Atkinson, Walla Walla, Chairman; L. L. Lanning, Walla Walla, and C. E. Cummins, Touchet. A. C. Moore is Clerk of the Board. E. R. Smith is the County Engineer.

OFFICIAL DOPE SHEET

Information About Three Concrete Bridges, Walla Walla County, Washington

CALL FOR BIDS. At 10:50 A. M. Monday, July 29th, 1929, the board of County Commissioners of Walla Walla County will open bids for the construction of three reinforced concrete bridges, one over the Touchet River at Johnson's Crossing, one over a dry run on the Waitsburg-Menoken Road one mile west of Waitsburg, and one over the Yellowhawk in East Walla Walla. The proposed Johnson Bridge is 111 feet in length and is made up of one 60-foot T-beam span and two T-beam approach spans. The south bank of the river is solid rock, the north bank is a gravel bench. Grading for the approaches is included in the contract. The site is seven miles north of the Oregon-Washington siding at Touchet. The Dry Run Bridge is a high 20-foot T-beam span with cantilevered ends making 40 feet of deck. The Yellowhawk Bridge is a 20-foot slab span with solid wings and abutments.

QUANTITIES: The larger quantities include:

JOHNSON BRIDGE		DRY RUN	
Excavation, Structure	375 cu. yds.	Excavation, Structure	90 cu. yds.
Concrete	370 cu. yds.	Concrete	90 cu. yds.
Steel Bars	45000 lbs.	Steel Bars	14000 lbs.
Excavation, Common	5400 cu. yds.	Backfill	40 cu. yds.
Borrow	2300 cu. yds.	Largest Pouring	25 cu. yds.
Solid Rock	135 cu. yds.	YELLOWHAWK	
Largest Pouring	58 cu. yds.	Excavation, Structure	90 cu. yds.
		Concrete	110 cu. yds.
		Steel Bars	6000 lbs.
		Backfill	230 cu. yds.
		Largest Pouring	42 cu. yds.

PRICES: Jones-Scott Company of Walla Walla quote the following prices: For the Johnson Bridge F. O. B. cars at Touchet, Sand \$1.95 per yard; Gravel \$2.25 per yard; Cement \$3.96 per bbl. gross. For the Dry Run Bridge F. O. B. cars at Waitsburg, Sand \$2.98 per yard; Gravel \$3.28 per yard; Cement \$3.96 per bbl. gross. For the Yellowhawk Bridge delivered at the bridge site, Sand \$3.25 per yard; Gravel \$3.50 per yard; Cement \$4.30 per bbl. gross.

DATE OF COMPLETION: The date set for completion is April 1st, 1930. The call for bids is officially advertised in the Walla Walla Times of July 5th, 12th, and 19th. Specifications are Lowman-Hanford print. Plans are on file in the office of County Engineer, Walla Walla, in the office of the Pacific Builder and Engineer, Seattle, and in the offices of the Associated General Contractors, Spokane, Portland, and Seattle. A deposit of \$5.00 is required to insure the safe return of the plans on or before the time of the opening of bids.

THE BOARD of County Commissioners of Walla Walla County is made up of C. E. Cummins, Touchet, Chairman; Henry Copeland, Walla Walla, and C. N. Eaton, Waitsburg. A. C. Moore is Clerk of the Board. E. R. Smith is the County Engineer.

of beams and a lighter floor resulting. Hollow square end posts hide the difference in sides of rail and add to the beauty of design. Another saving in material and formwork results from the elimination of all battered walls and the substitution of a thickened rein-

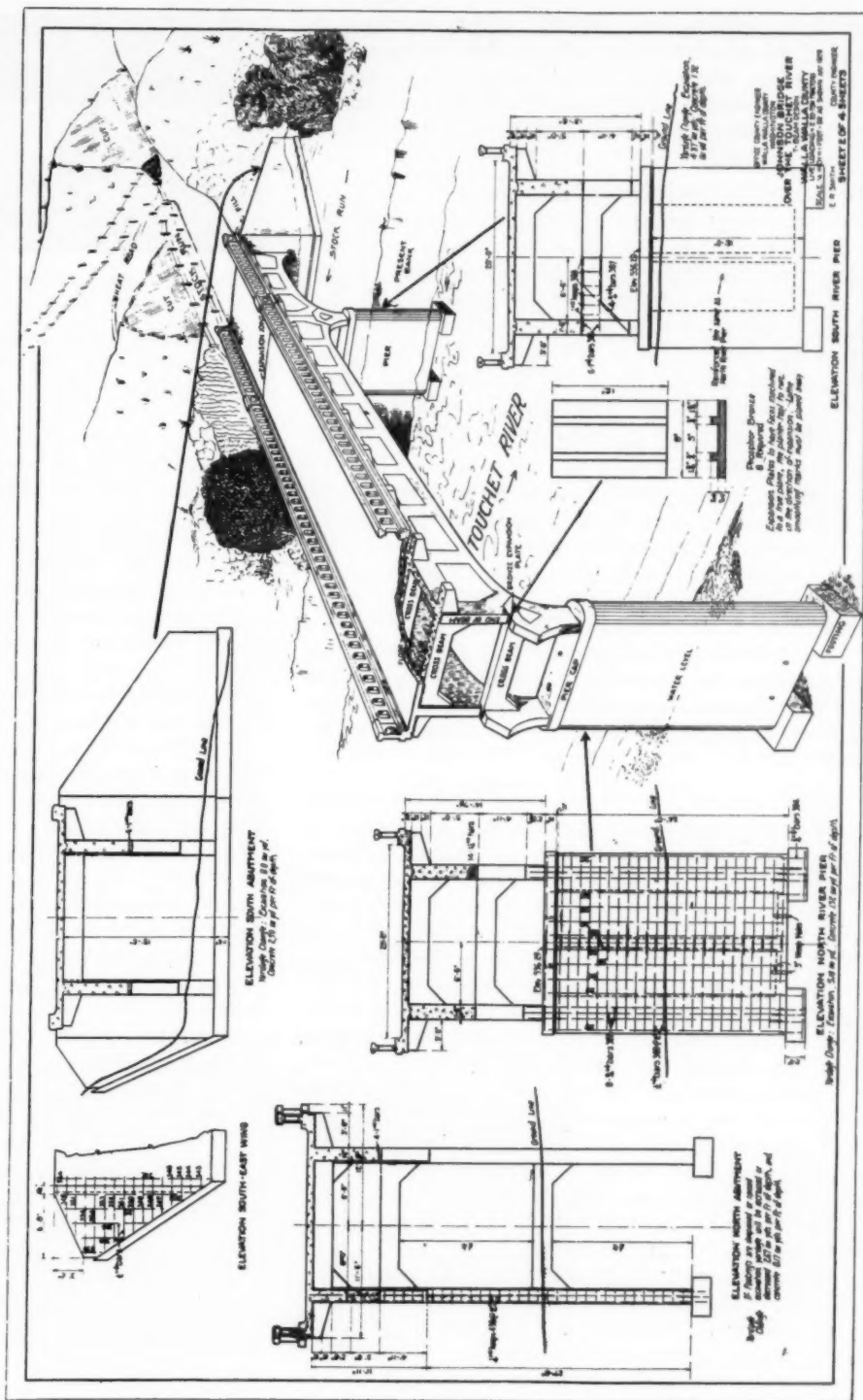
forced corner to hold wings to abutments. Bulkheads only nine inches thick top and bottom, and even twenty feet high, are successful if curved in eight-foot panels or tangents.

Care in details adds much to the architectural appearance of the bridge. Half-inch half-round drip molds help keep the rails and beams free from unsightly water stains. A three-inch gutter on the top of wing walls does as much for the wing wall faces. A dished top on a pier with a concealed pipe to the river carries rain water away better than copper water stops between spans. Parts should be balanced. Expansion materials look better around intermediate posts than through them. End posts should slope away from the bridge. White and colored cement paints and stuccos add to the appearance, at very little cost. They should be waterproof and non-fading. Panels of dark color will lighten to the eye a beam that is actually thick and heavy.

Riding qualities of a bridge having a paved deck are improved by the use of longitudinal strike bars and floats. The lights of a car placed at the end of a newly poured span will show up defects in the surface. End lips (beveled floor extensions) are used on bridges where there will be no immediate paving of approaches. These take up much of the jar due to settlement of fills at the approaches.

When the plans are finished and while the call for bids is being advertised, Walla Walla county distributes an "official dope sheet" not only for bridge work but for highway work as well. This sheet or circular is mailed to all bridge or highway contractors within bidding distance three weeks before the opening of bids. This sheet gives approximate quantities, dealers' prices of materials, date of completion, and important data concerning the proposed project. There is printed in one corner of the circular a sketch or small perspective of the proposed structures. For a road project, a vicinity map is used instead. In order that this information be at all valuable to the prospective bidder, the quantities involved must be very approximately correct

and precautions taken in checking volumes and weights. The contracting profession of the Northwest is entirely in favor of this method of distributing condensed advance "dope." Recently the Portland (Oregon) Bridge Company said of these sheets: "Your manner of presenting the matter may not be entirely in accordance with some engineer's ethics, but from a contractor's viewpoint I can say without hesitancy that you include more real information in your little official dope sheet than is usually presented by the average engineer with an entire set of blue prints and a voluminous set of specifications." Gumaer and



Sample of Construction Tracing, Showing Shaded Perspective "Cut-Away"

Straalsund, contractors, write: "Your courage in bringing to the contracting element something of real value to them, which something lies beyond the ability and ethics of engineers in general, is indeed a valuable step forward in a field avoided by those with less courage than yourself."

In return for our efforts to place in the hands of the contractor a large amount of reliable, but abbreviated, information, we not only stimulate interest in county projects but we supply plans, blue prints, and specifications to only those contractors who actually bid. Before the opening of bids on a recent road project, 200 dope sheets were mailed to contractors, 22 sets of plans were given out, and there were 20 bids. Dope sheets about a bridge project were recently mailed to 100 contractors, 10 of whom asked for plans, and of this number 9 turned in bids.

For the man who bids on the work, we enclose with each set of plans, in addition to the usual bid sheet, a second and informal proposal form. On this sheet are listed in detail all materials entering into the bridge, with quantities of each and local prices, with a space for extension and addition. There are several items of labor, insurance, bond and profit. As a result, the low bidder has no chance of leaving anything out and saves time in getting his figures. This sheet is not submitted with the bid but is for the contractor's convenience only.

Another unusual feature is designed for the contractor who looks over the plans, estimates the work, and builds the structure, and for his carpenters, foremen, and workmen of every kind. To many of these people the average blue print is just a maze of lines and a profile may resemble a fever chart. Broken lines depicting steel reinforcement bars add to the confusion. Everything is in one dimension. There can be no depth. Even shades and shadows are taboo. But Walla Walla county has adapted a method employed by architects, namely the perspective, and has added to it the cut-away sections used by the build-your-own departments of some national magazines. In place of the conventional plan, end view, and side elevation, a shaded perspective is shown near the center of the tracing. This is "cut-away" to show various thicknesses and hidden features. Around this drawing are grouped projections of the structure drawn in the usual way, and enlarged details. The eye follows an arrow from the detailed sketch to the particular section shown in the perspective. Thus the drawing lives before the eyes of the carpenter and form builder. The superintendent can visualize his forms and bracing. The commissioner and laymen can see into what the estimated money is going before the contract is let. And even the engineer and draftsman can tell what it is all about and have a chance to perfect the vision. The disadvantages of the perspective is that a scale cannot be used directly on the blue print. It serves merely as a guide to the other drawings. Complete bending diagrams for steel, and pouring tables for concrete, giving detailed amounts of cement and aggregates, further facilitate the work of building the structure.

During the construction of the bridge, the inspector on the work checks materials, dimensions, and forms. Water control is under observation. Partial payments are liberal. A model of the bridge is kept on the work



Square Bridge Crossing Railway on a Skew

for reference. And with the completion of each structure, there is compiled a book of statistics which bear out the estimates and serve as a basis for future design.

Water and Sewerage Improvements in Missouri

The following cities have recently passed bond issues for water and sewerage improvements:

Belton voted a \$99,000 bond issue for the construction of complete water and sewerage systems; \$62,000 for the water system and \$37,000 for the sewerage system.

Platte City voted a \$36,000 bond issue for the construction of a complete water system.

Warsaw voted a \$100,000 bond issue for the construction of complete water and sewerage systems; \$60,000 for the water system and \$40,000 for the sewerage system.

Sweet Springs voted a \$65,000 bond issue for the construction of additions and improvements to the present municipal water system.

Preliminary plans for a complete sewerage system and sewage treatment plant at DeSoto have been approved by the State Board of Health. Also, preliminary plans for a complete water and sewerage system for Gilman.

Final inspection and approval of the recently completed water purification plant at Wellsville was made by the State Board of Health.

Ohio River Basin Water and Sewage Problems Discussed

Chief engineers of eleven state health departments signatory to the River Basin Sanitation Agreement assembled recently at Pittsburgh for their fourth annual meeting to discuss sewage and waste disposal and other sanitary problems of interstate interest.

The chief subject under consideration was the protection from pollution of those water supplies which are drawn from the Ohio river and its tributaries and which serve approximately five million people. The necessity for such protective measures is emphasized by the extremely rapid growth of cities and industrial activity in the Ohio river basin.

The question of the advisability of a resurvey of the Ohio river was considered, a representative of the United States Public Health Service being present. Such a resurvey would make it possible to ascertain what changes in sanitary conditions have been brought about by dam construction, by natural increase in population and by industrial development since the last survey was made in 1914-1919.

Reconstruction of Highways in Massachusetts

Stone in wearing course coarser than that in base course, giving a rough wearing surface. Adapting foundation to wider pavement and modified alignment. Handling traffic.

By F. E. Cassidy*

As a part of the reconstruction of the Mohawk Trail route from Boston to North Adams, the Massachusetts Department of Public Works on May 7, 1929, awarded to R. E. Bull, of Fitchburg, Mass., at a bid price of \$212,141.50, a contract for the reconstruction of 4½ miles of road from the Orange-Erving town line extending westerly to the village of Farley in the town of Erving.

This project, which called for a standard bituminous asphalt macadam of the penetration type 24 feet wide, with standard banking on curves, offers a very good example of what the Massachusetts Department of Public Works is doing in the way of salvaging existing roadway surfaces in the process of reconstruction and widening its main highways.

The old road consisted of two types of surface, that on the easterly half of the project a water-bound macadam 15 ft. wide with a cold oil blanket built in 1905-6; and on the westerly half of the project a bituminous macadam 15 ft. wide with oil blanket resurfaced in 1912 and 1914. However, the surface has been widened from time to time under the maintenance forces so that at the time of reconstruction the surface was in general about 18 ft. wide.

The alignment of the old road was poor, as there were numerous curves, some of which gave a very limited view ahead. In the reconstruction work the alignment has been improved greatly by the flattening of curves and changing the line of macadam so that in some instances it is entirely off the old roadway. Owing to local conditions, however, it was necessary to follow the old roadway in general, and in doing so endeavor was made to use the existing surface as far as possible for a base for the new surface.

In designing the grade for the new road it was planned to keep about 3 inches above the old surface, except when it was necessary to vary from this in order to improve an existing grade.

The new pavement was designed to consist of 7 inches of broken stone where gravel foundation was used. Where the new grade was less than 7 inches above the old macadam surface and no foundation was used, the depth of stone was made whatever was necessary to bring the surface up to the new grade.

Where change in line brought the new surface outside the old surface, or where the new grade was less

than 3 inches above the old surface, a 12" gravel foundation was used; the old macadam as well as the soil being excavated to a depth sufficient for this purpose.

Where the new surface was built on the old macadam and the grade of the new road more than 3 inches and not over 7 inches above the old road, the new surface was brought up to grade with broken stone. If the grade of the new road was greater than 7 inches above the old macadam, a foundation of gravel of variable depth over the old road was used to bring the foundation up to 7 inches below the new grade.

ROUGH GRADING AND EXCAVATION

The work involved the excavation of about 31,500 yards of material, of which about 2000 yards was ledge. It also required about 11,700 cubic yards of borrow in addition to the excavation to make the necessary embankments. The excavation work was done by two Northwest gas shovels, one of which had a 1 cubic yard bucket and the other a ¾ cubic yard bucket.

The borrow, of which there was about 30,000 cubic yards including the gravel borrow used for foundation, was obtained from pits near the work and loaded by the gas shovels into trucks, of which a maximum of twelve were used. The 3½-ton Larrabee and International and 5-ton Mack trucks handled the borrow very efficiently.

An Ingersoll-Rand compressor mounted on a Ford chassis did all the drilling for the ledge removed.

DRAINAGE

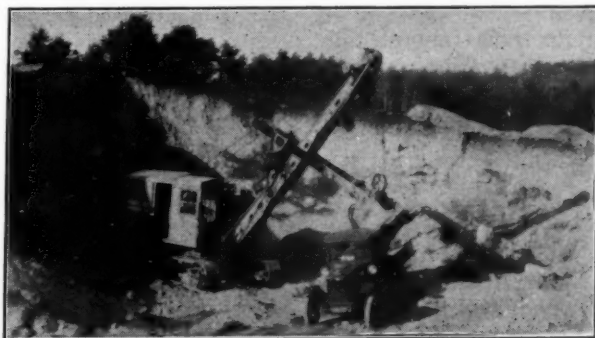
A considerable amount of drainage was required for this project, a total of 12,500 lineal feet of pipe being laid. Reinforced concrete pipe of various sizes from 12-inch to 48-inch was used on this work, and in addition about 10,000 lineal feet of

vitrified clay pipe was used in drainage systems and side drains.

All trench excavation for drainage was done by hand labor, with the exception of the 48-inch reinforced concrete pipe, which involved the removal of a broken-down concrete culvert, and this excavation and laying of the new pipe was done by a gas shovel.

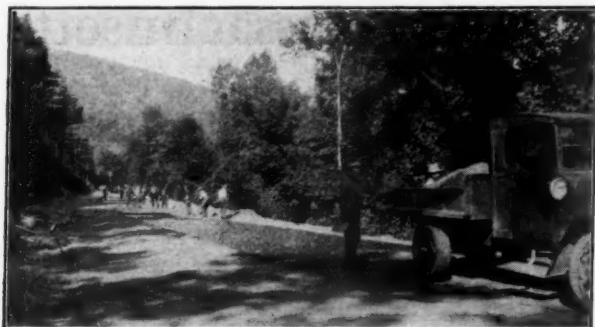
FINE GRADING AND FOUNDATION

Due to the fact that much of the old macadam was being salvaged, the grading for foundation, where necessary, and for the base course of broken stone involved some scarifying, some excavation with a power shovel, and some hand excavation.



Shovel loading truck at gravel pit

*Assistant civil engineer, Massachusetts Dept. of Public Works.



Completing the Surface Near Erving

Where the new surface was laid over the existing macadam and not more than 7 inches of broken stone was required to bring the new surface up to finished grade, the old surface was scarified to a depth of not more than 3 inches by means of a scarifier attached to a steam roller, in order to obtain a proper bond between the old stone and the new.

On the widenings outside of the old macadam, which varied in width from 1 foot to full width of roadway, gravel foundation 12 inches deep was required. The excavation for these widenings, where necessary, was done by means of the gas shovel where the trenches were of sufficient width to be able to use a shovel dipper. Where the trenches were less than 2 feet in width, the necessary excavation was done by hand labor.

The use of a tandem roller was found to be very efficient in properly rolling the foundation gravel on these widenings. This roller was used also in compacting embankments, which were built in layers 12 inches deep, each layer being rolled thoroughly.

Where it was necessary to excavate the old macadam to secure the desired grade, or to put in a foundation owing to poor subsoil, this excavation was done by means of the gas shovel.

As it was necessary to maintain traffic through this work at all times, only half-width excavation could be done at one time, and this was backfilled with gravel and travel turned onto this foundation before excavating the second half of the road.

All subgrade (in other words, the plane of the bottom of excavation and the top of fills) was shaped to the true cross-section of the proposed roadway and thoroughly compacted by means of a 12-ton steam roller before any foundation material was placed on the subgrade; and this foundation, which was laid in two courses each 6 inches deep, was thoroughly rolled before any base course stone was laid.

PAVEMENT CONSTRUCTION

The project called for earth shoulders 2 feet wide in cuts and on fills of such depth as did not require guard-rail, and a 4-foot shoulder on guard-rail sections.

Before any base course stone was laid, a shoulder was built sufficient to hold the stone in place and wide enough to enable a roller to lap onto it half the width of a roller wheel when rolling the base course.

As the surface had a maximum depth of 7 inches of broken stone in two courses, the top or wearing course being $2\frac{1}{2}$ inches when rolled in place, the base course was of variable depth, depending upon whether the new surface was over the old or outside of it and the relation of the new grade to the old.

The base course was of trap rock having a French coefficient of wear of not less than 10 and a toughness of not less than 8, and composed of No. 1 and No. 2 stone mixed, the proportion of No. 2 stone being limited to 40% of the mixture at any one place. (The No. 1 stone varies in size from $2\frac{1}{2}$ inches to $1\frac{1}{2}$ inches, and the No. 2 stone from $1\frac{1}{4}$ inches to $\frac{3}{4}$ inch.)

In order to maintain traffic, it was necessary to build the surface one half at a time, and the base course of the first half was laid 14 feet wide and to a depth which, after thorough rolling with a 12-ton roller, was true to the desired cross section of the road and $2\frac{1}{2}$ inches below finished grade. Any depressions that developed after rolling were filled with broken stone and thoroughly rolled, after which the course was bound with clean sand and rolled until the stone was thoroughly compacted. Any surplus sand was broomed off, leaving the top of the broken stone free from sand. In rolling this base course, one rear roller wheel lapped over about half its width onto the shoulder. Buffalo-Pitts steam rollers were used to roll all broken stone, which was spread from trucks and the spreading completed by men with stone forks. Mechanical spreaders were not used on this work.

SURFACE COURSE

The base course having been satisfactorily completed, a surface course of No. 1 stone, French coefficient 14,



Finished surface. Note roughness

toughness 12, was spread on the base to a width of about 13 feet, leaving at least a foot shoulder of base course stone outside of the surface course. This stone, as in the case of the base, was spread from trucks and further spreading done by hand. A shoulder was built to hold this top course, and in rolling the stone, a rear wheel overlapped onto this shoulder about one half the width of the wheel.

The depth of stone when rolled was $2\frac{1}{2}$ inches, and before asphalt was applied this surface course was thoroughly inspected by the engineer in charge of surface work and any depressions or irregularities in the stone were perfected before allowing the application of bitumen.

When the surface course stone was satisfactory to the engineer, it was penetrated with asphalt applied from distributor trucks at the rate of $2\frac{1}{4}$ gallons of asphalt per square yard, and for a width of 12 feet, leaving a shoulder of about a foot of surface stone to retain the proper shape of the roadway when the roller wheel was on the edge of the penetration.

The asphalt was applied at an average temperature of 335° F., using Standard Oil Co. Binder "C" 85-100 penetration until September 1st, after which Binder "B" 100-120 penetration was used.

Immediately after the application of asphalt and before any covering was added, the roller was sent

onto the asphalt to roll out the surface. The asphalt was prevented from adhering to the roller wheels by means of water applied to the wheels while in motion, through the medium of a sprinkler system attached to the rollers.

After the roller had gone over the area covered by asphalt a sufficient number of times to remove any depressions or marks left by the distributor truck, a very light coating of $\frac{3}{4}$ -inch stone was applied to fill the voids. This was followed by further rolling until the surface had attained its true cross section. Any surplus $\frac{3}{4}$ -inch stone remaining on the surface was broomed off.

A seal coat of $\frac{1}{2}$ gallon of asphalt to the square yard was later applied over the penetration, and this covered with $\frac{1}{2}$ inch or pea stone uniformly spread and broomed into the voids, and this followed by a final rolling.

Two types of distributors were used on this work, the Standard Oil distributor mounted on a Mack truck chassis, and an "Etnyre" type distributor.

The asphalt was heated in tank cars by means of a steam boiler set up in the railroad yard at Millers Falls and hauled in the distributor truck to the job with an average haul of about six miles.

In order to keep the line of one-way traffic as short as possible, about half a mile of surface on one side was built, and the contractor then went back and closed in the opposite half of the road, turning traffic onto the finished surface.

CONSTRUCTION METHODS

Sand for binding the base course of broken stone was distributed in piles on the shoulders of the road, using about 8 cubic yards per hundred feet of surface. This sand was distributed immediately after the subgrade had been made ready for base-course stone.

Pea stone for the covering of seal coat was likewise distributed along the shoulders, using about 5 tons of stone per hundred feet.

The $\frac{3}{4}$ -inch stone for covering the penetration course was spread from a small truck as used, the stone having been dumped in large stock piles conveniently located along the job.

Broken stone for the surface was shipped in on cars from commercial quarries, the Lane quarry at Westfield, Mass., and the Massachusetts Broken Stone Co. at East Deerfield, Mass., being the chief sources of stone.

A side track into the plant of the Heywood-Wakefield Co. at Erving, practically midway of the job, offered a very fine opportunity for unloading cars of stone. As the plant for which this sidetrack was used had shut down, the contractor was able to dig an unloading pit on this side track and, by means of a Barber-Greene belt conveyor 24-inch x 30-foot long, was able to unload as high as 500 tons of stone a day into trucks.

TRAFFIC CONDITIONS

Owing to the heavy motor traffic on this route, it was specified in the contract that the

road be kept open for travel and built one-half width at a time. The contractor was not allowed to disturb more than two miles in total length and not more than about one mile at any one place in length of existing road surface.

Traffic men were on duty 24 hours a day to expedite the movement of traffic through the work.

The surface was started on July 8th and completed October 17, 1929, about 23,000 tons of stone having been placed and 181,000 gallons of asphalt applied in building this surface.

About 8200 lineal feet of cable guard rail with concrete posts was built, and in addition about 4300 lineal feet of wooden guard rail removed and reset, the latter having been built by the maintenance department within the past two years.

EQUIPMENT

In addition to the equipment mentioned above, a Jaeger mixer of 1-bag capacity was used in mixing the concrete for drainage structures.

In the finishing of shoulders, a gas shovel was used to good advantage in loading surplus material into trucks, to be hauled to points along the road where necessary to be used on the slopes.

The maximum number of laborers used on this project was 80. The work was done under the supervision of R. E. Bull, the contractor, who was assisted by Frank Mosher, superintendent.

PERSONNEL

H. D. Phillips, district highway engineer, was in general charge of the work for the Massachusetts Department of Public Works and was assisted by W. G. Burns, senior engineer in charge of construction work. H. C. VanWagner was resident engineer on this work, assisted by D. A. Harrington, who was in charge of surface work, and J. H. Tighe, senior engineering aid. The writer had supervision of this and several other projects within the district.

Water Supply Control

The New York State Department of Health has prepared for distribution to those in charge of water purification plants a 118-page bulletin giving information upon the protection of water supplies from pollution, watershed control, use of copper sulphate, operation of filtration and chlorination plants, and a non-technical discussion of simple procedure for laboratory control.



Portable belt conveyor loading stone into truck



Industrial railway outfit on levee enlargement job at Hickman, Ky. A Northwest shovel loads into Kentucky 6-yard cars. The borrow pit is in the hills near the end of the contract

Industrial Railways Build Levees in the Reelfoot District

Narrow-gauge cars used to haul material from the hills near one end of contract nearly a mile long, and a drag-line for placing it on the levee

In the Reelfoot Levee District, which is located about fifty miles south of Cairo, Ill., on the east side of the river, there are three important construction projects now under way, and scheduled for completion in the early part of 1930. One of them—a combined dredging and dragline job, involving more than two million yards of levee work—is described in another article to be published in an early issue of *PUBLIC WORKS*. The job described in this article illustrates another method being tried out in levee construction, and the third method—by the use

of heavy draglines—will be described in another article.

Contract No. 6 begins at the hills of West Hickman, Ky., and involves the construction of 4,250 feet of levee having an average height of 16.0 feet. The contract yardage amounts to approximately 150,000. The type of construction is landside enlargement of the section shown in Fig. 4. Fig. 1 illustrates the general layout of the job. This is a "haul-in" job, the earth for the levee being secured from the hills at the east end of the job. The contract was awarded to the Missouri Engineering & Construction Co. at a unit price of 31 cents per yard. A period of 150 calendar days is allowed for construction.

METHOD OF CONSTRUCTION

The general method adopted for handling this job involved the use of narrow-gauge industrial cars for hauling the material from the borrow pit, and a small dragline for placing the earth on the levee and finishing to proper section.

The old levee forms the riverside

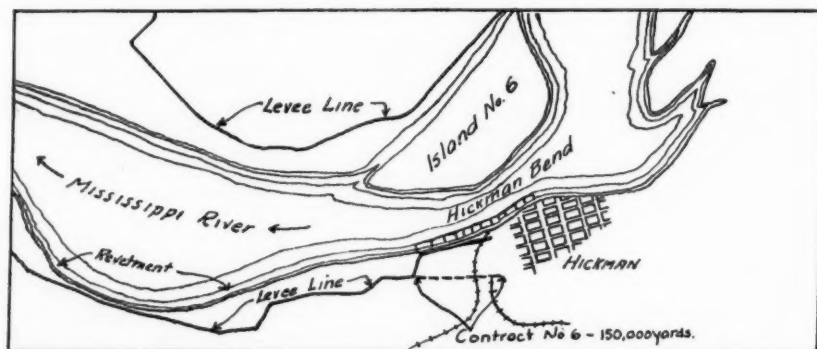


Fig. 1—Location of Contract No. 6, Hickman, Ky.

toe of the new section, and on this the tracks for handling the dirt were laid. At one point the narrow-gauge line crosses the tracks of a branch of the Illinois Central Railroad. Here an ingenious device was employed. The narrow-gauge tracks were built up to the rails on either side of the railroad tracks, a bearing placed in the center of the tracks, and lock-joint rails set for easy placement or removal. These could be lifted out quickly, or set in place, and very little delay resulted, while traffic was maintained over the I. C. branch.

At the borrow pit, a Northwest $1\frac{1}{4}$ -yard gasoline shovel loads into the cars. There are twelve of these cars, side-dump, 5-yard capacity, manufactured by the Kentucky Wagon Works, Louisville, Ky. They are handled in two trains of six cars each by a Plymouth 12-ton gasoline locomotive.

The track layout is shown in Fig. 3. A train of empty cars is spotted at the shovel, while the loaded cars are run to the levee and dumped. The shovel loads the cars, moving the train forward with the dipper as necessary to facilitate the loading. When the load of empties is brought back, these are coupled to the loaded cars, which are then pulled down beyond the switch, Fig. 3, and pushed into the siding. The empties are then uncoupled, taken out of the siding, and spotted for loading. The locomotive then returns and picks up the loaded cars to take them to the levee.

As shown in Fig. 4, a dumping pit is maintained along the narrow-gauge tracks which are placed on the old levee. The cars are dumped into this pit or ditch, and the earth rehandled by a Northwest $1\frac{1}{4}$ -



Northwest dragline shaping up level section. Narrow gauge track at right. Dumping pit between track and dragline. Water standing everywhere due to three days of rain

yard crawler-mounted gasoline dragline with a 50-foot boom, which travels on the uncompleted levee. This dragline completes the levee section and brings it to proper grade and shape.

Unusually steady progress has been maintained with this outfit and work has been possible even under unfavorable weather conditions. An average daily yardage of 1200 to 1400 has been maintained, operating on two shifts, and working from 18 to 22 hours per day. The average force employed on the job, for both shifts, is usually around 15 men.

This work is under the general direction of the First Field Area of the Memphis Engineer District, Mississippi River Commission, and is located in the Reelfoot Levee District, of which H. T. Slade is engineer and inspector. J. C. Ransburgh is resident inspector on the work.

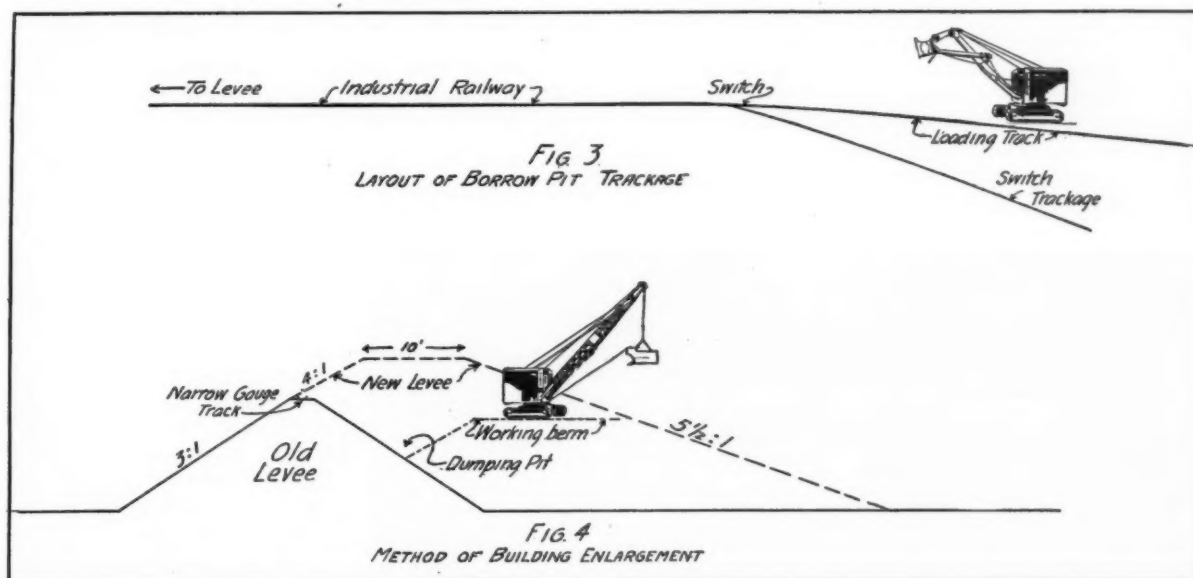


Fig. 3. Above: Layout of track at Borrow pit. Fig. 4. Below: Placement of dragline and method of working on enlargement



Austin Trencher and Northwest Crane With Large Pipe Tongs on Dallas Water Works Extension

Equipment for Laying Cast Iron Pipe

Dallas contractor uses ditcher, back-filler, portable compressor, crane, power shovel, and heavy pipe tongs, in addition to customary small equipment

Dallas, Texas, is carrying out a comprehensive extension of its water supply system which will cost about four million dollars, and which includes filtration and pumping plants, and trunk line distribution mains up to 60 inches diameter. All of the mains are of cast-iron pipe.

On January 7, 1929, a contract was let for the construction of 78,360 feet of 36-in., 19,800 feet of 30-in., 10,200 feet of 24-in., 3,600 feet of 18-in., and 2,220 feet of 16-in. mains, with fittings, totaling 25,000 tons, to the United States Pipe and Foundry Co., for \$1,265,294. This company sublet the laying of the pipe to the Uvalde Construction Co. of Dallas.

The Uvalde Construction Company assembled the

most modern equipment possible and started excavation on April 8, 1929. In addition to small tools, chain blocks, braces, melting furnaces, etc., was a specially built Austin ditcher, an Austin back-filler, a Sullivan portable compressor, a Northwest caterpillar crane for handling pipe, an Erie shovel for rock and deep excavation, and a giant pipe tongs for handling the pipe into the ditch. The efficiency of this apparatus has excited favorable comment, as has also the power drill specially designed by the contractor for rapid drilling of the chalk rock. This drill averages $2\frac{1}{2}$ to 3 feet per minute in shallow holes. With an experienced crew the schedule rate of progress has been maintained, and at times amounts to 1200 feet of 36-in. pipe per day.

The jointing material for the entire contract is being furnished by the Leadite Company of Philadelphia. The "two cone" method of pouring "Leadite" is being used, which insures complete circulation of the molten material around the joint and the complete elimination of air bubbles and porosity.

Many underground structures and also grade crossings (which will be eliminated by the city planning of



36-inch line carried across ravine

the future) necessitated the highest skill of the engineers and the contractors to maintain economy and efficiency of construction. The large lines had to be laid at proper depths to avoid disturbance that so often follows new grades. Some depths in very congested areas exacted skill and care of the highest order. At the Greenville Avenue crossing the trench is 20 feet deep, part of which is through solid rock. The engineering survey has resulted in few railroad crossings being required in an area of considerable trackage. Five railroads, two interurban lines and three street car systems had to be crossed. Two of the crossings are in rock, of which one was accomplished by a tunnel five feet square and twenty-eight feet long.

Many unusual soil formations, particularly in the deep cuts, confronted the contractors. Ground water appeared unexpectedly and added to the difficulties. The weather, however, was good so that there has been an uninterrupted daily demonstration of the value of proper equipment and organization.

For the above description and the illustrations we are indebted to the U. S. Pipe & Foundry Co.

Refuse Disposal in Baltimore

Baltimore, a city of about 900,000 population, in 1929 discarded about 95,000 tons of rubbish, which was delivered to two incinerators. The rubbish is collected by contract, this method having been introduced in the latter part of 1926, previous to which all rubbish had been collected and hauled to the incinerator by the Street Cleaning Department. Collecting rubbish by contract is said to have proved very satisfactory and caused a regular daily flow to the incinerators. In 1927, the first year of such collections, the amount of rubbish was only 46,000 tons, which increased to 83,000 the year following and to approximately 95,000 in 1929.

All rubbish is hauled to one of two incinerators. One of these, of the Davis type, was completed in March, 1924, at a cost of \$100,000. It is located near the northern boundary of the city, adjacent to an old quarry hole owned by the city, into which the ashes and cinders can be wasted.

When this plant had been operating about six months it was planned to build three more of the same capacity and type, so located as to give a minimum haul from all parts of the city. Due to the difficulty in obtaining sites, however, this idea was abandoned and it was decided to increase the capacity and efficiency of the existing plant, and to build one additional incinerator in the southeastern part of the city. The first incinerator was remodelled, making it a two-story building and increasing the capacity to approximately 175 tons a day, and its operating time was changed from 8 hours to 24 hours. The second incinerator, with a capacity of 250 tons per 24 hours, was completed in December, 1927, at a cost of \$225,000. This is built on land owned by the city, located on high ground with a ravine and a large area available for the disposal of the ashes for many years.

Arrangements for salvaging paper, rags, metal, bottles, shoes, tin cans, etc., are provided at the plant.

On arriving at either plant the trucks dump their contents into a pit. At one plant the rubbish is raked



Lowering Pipe Into Trench Cut 20 Feet in Solid Rock

from the pit onto a conveyor at the bottom of the pit; while at the other plant it is raised by means of a grab bucket and loaded onto the conveyor. The conveyor belt travels at a speed of about 30 feet per minute and carries its load to the upper floor, where women on both sides pick out articles that can be salvaged or which are too large to be charged into the furnace. Bottles are sorted and the other materials are pressed in baling presses and sold to dealers. The unsalvaged material falls off the end of the conveyor into the furnace hopper. This is at one end of the furnace and loads the material onto a chain grate stoker which moves at a speed of from 2 to 8 inches per minute. The material is burned on this chain grate and the ash falls from the end of the chain grate into a chain bucket conveyor which drops it into one-yard dump cars, which in turn dump it onto low land outside the building. About 15% of the rubbish is salvaged and 85% incinerated. Incinerators run from 16 to 20 hours a day, and employ an average of 100 men and 50 women.

The amounts of the various materials salvaged, and the funds received from them during the year of 1928, were as follows: papers and magazines, 14,172,203 lbs., yielding \$40,943; rags, carpets, burlap, etc., 833,306 lbs., yielding \$14,260; bottles, 1,071,636 pieces, yielding \$7,460; broken glass, 2,990,756 lbs., yielding \$5,574; baled tin cans, 10,218,290 lbs., yielding \$8,644; iron, metal, rubber, etc., 624,687 lbs., yielding \$5,655. This gives the total sum received from salvaged materials of \$82,536; or approximately \$1.00 for each ton of rubbish delivered at the plant.

Abstracts and Summaries of Papers at the American Road Builders Convention

At the technical session of the A. R. B. A. meeting there were presented a large number of excellent papers and committee reports. The number and bulk of these prevent giving more than brief abstracts of them, except in a few selected cases. Those wishing these papers and reports in full may write to the American Road Builders' Association at Washington, D. C.

City Officials' Sessions

A number of the excellent papers and reports presented at the sessions of the City Officials' section are given in summary herewith. Full texts of these papers will be published in the proceedings of the American Road Builders' Association.

Assessing and Financing Pavements

Chairman, E. R. Kinsey, President, Board of Public Service, St. Louis, Mo.

Assessing.—Real estate without accessibility has little or no value. When, therefore, private property is especially enhanced in value by a public improvement there seems to be no good reason why the general public should bear the entire cost. To the extent that values of private property are thus increased, a special assessment is wholly justifiable.

With a street improvement of normal width on which all the abutting lots on each side are of equal depth, rectangular, similar in character, and the nearest parallel streets on each side are the same distance away, practically all the common methods of assessment in use give the same result, providing the whole cost is to be borne by private property.

With the improvement of a cross street the problem ceases to be simple. Should the front foot rule be used here? That would not be fair as the entire burden would be borne by the corner lots whereas the improvement would be used by lot owners for a considerable distance on each side of the improvement; but the corner lot should bear more than an interior lot, whether used for business purposes or for residence purposes.

The writer asserts that in the case under discussion there is no such thing as diminishing benefits, and a lot 150 feet from the cross street has just as much need for and just as much use of a cross street as has one only 50 feet away.

Financing.—Many contractors are forced to pay heavily for the capital used in the construction work. This is particularly true if they are paid only on completion of the work, and then with bonds or tax bills which must be sold or collected. The cost of discounting paper and borrowing money comes out of the taxpayers' pocket. All this financing could be obtained

at lower cost by the city itself. An issue of bonds or tax bills of questionable validity costs the taxpayer much money and often it is the wrong taxpayer who pays. If contractors occasionally absorb such losses and still stay in business it is because they bid high enough to collect their losses from those against whom valid assessments have been made.

In St. Louis the assessment is made after the street improvement has been completed. The total cost is ascertained, including intersections and also including engineering costs which are limited to six per cent. One-fourth of the cost is assessed against the abutting lots, ratably by frontage; the remaining three-fourths is assessed against the property in the district (including the abutting lots) ratably by area. These are provisions of the City Charter. The establishment of the district is a legislative enactment, proposed first by the city's engineers and then passed by the Board of Aldermen. Each district stands on its own bottom, subject to attack and defence in the courts.

Uniform Cost Accounting

Chairman, C. A. Hillegas, Supt. Highways and Sewers, Pittsburgh, Pa.

The object or purpose of a uniform system of accounts in street and highway work is the establishment of a system of measures and costs that will make possible an intelligent comparison between the results obtained by different organizations doing similar work. There are two distinct ways of approaching the problem. One is to use the financial records of the organization, having them set up in accordance with the classification determined upon, and the other is to set up a cost accounting procedure entirely apart

from the financial accounting. From my experience with governmental bodies, I do not believe that it is either possible or practical to establish a uniform classification of measures and costs based on the financial accounts that would be of any real value for comparative purposes.

This brings up the possible use of a cost account system as a base. The ob-

jection to the use of data furnished by cost accounting systems as the basis for measures, is the cost of the additional clerical work involved. This should not be serious, if a sensible system is laid out.

There is no mystery to cost accounting. It is composed of two elements, i.e., the measuring and recording of results of all operations and recording of the cost of labor, materials, supplies and plant and equipment used in obtaining those results. Whether the data is assembled by a centralized accounting force or by the existing clerical force in the field, really

Francis I. Jones, director general of the United States Department of Labor's Employment Service, says in his introductory summary of a special survey of "industrial, agricultural and general employment prospects for 1930":

Road construction and public improvements will exceed by many millions the 1929 program.

makes very little difference. The basic cost data must come from the job where the labor, material, etc., is actually used. This will be in the form of time cards, showing in detail the use of labor, and reports showing in detail the use of material, supplies and plant and equipment. The distribution of these items by function or by job, or both, can be readily made by any clerk, once the proper forms are designed, or if there is a sufficient volume of work, by machines designed for this purpose.

Airports

The report of the Municipal airport committee has been compiled in pamphlet form, and copies are ready for distribution upon application to the American Road Builders' Association. The material presented covers a complete range of subjects bearing on airport construction, including layout and planning, structures, drainage, surface, management, lighting, housing and public accommodation. Parts of this pamphlet will be abstracted for publication in succeeding issues of PUBLIC WORKS.

Pavement Wearing Surfaces

Chairman, Nathan L. Smith, Highway Engineering Department, Baltimore, Md.

The fact that practically every large city reports the use of sheet asphalt for its primary highways is sufficient recommendation for this excellent type of pavement, combining as it does many desirable qualities. It can be adapted to most any condition of climate, topography or traffic. The ease with which repairs can be made to asphalt surfaces either after failures in the pavement or cuts for subsurface installation is, however, one of the real arguments in favor of their use. These patches, if carefully made, are scarcely noticeable after traffic has gone over them for a few days. The value of these bituminous pavements for surfacing old cement concrete, vitrified brick or granite block streets, or macadam roads, is another argument in their favor.

The engineer using this pavement must give due consideration to the volume, weight and speed of traffic on each thoroughfare during the greater part of the year and draw his specifications so that the finished pavement will be at its best under these conditions. Too much emphasis can not be laid on the necessity for careful raking and thorough compacting to secure a uniform density as well as a smooth surface.

Vitrified brick paving is popular in many cities. The type of cushion and filler to be used are important and there are many arguments in favor of each. A consideration in the selection of a filler is the inconvenience to traffic during the constructing and maintaining of the surface. The grouted pavement requires several days to cure while the asphalt filled surface can be opened to traffic immediately.

When the joints between the bricks are fully filled with a well-cured portland cement grout, the edges of the brick blocks are fully supported and the bricks are solidly anchored together. The bituminous fillers

offer little support to the edges of the brick, but most asphalts solidly anchor the blocks together. The tighter the bricks can be laid together, the better the edges of the blocks are supported. Tight joints, however, are harder to get well filled with the hot bitumen than open joints. Tight joints or joints not exceeding one-eighth of an inch in width are the rule in the surveyed cities.

Many conclusions in regard to brick pavements are true of stone block. If properly bedded and bound, this is perhaps the most durable of all pavements, but the cost is so great that only a few of the larger cities use them and they only where extremely damaging traffic is experienced.

Much research and promotion work has been done in connection with the use of cement concrete wearing surfaces recently, with the result that this material is being used in large amounts each year.

Finishing machines and machines for the construction of longitudinal and transverse planes of weakness are quite generally used for the construction of concrete pavements between cities, but these machines are not easily adapted to the building of pavements in city streets where the width of the roadways vary and the cross-section changes from point to point along the pavement.

The use of reinforcement is recommended by some engineers and undoubtedly adds to the strength of the pavement, but it is a distinct disadvantage if it becomes necessary to make cuts for the installation of utility connections after the pavement has been completed.

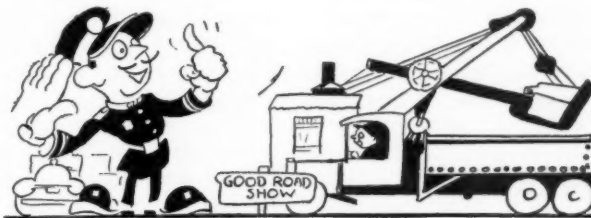
Street Railway Tracks and Paving

Chairman, R. H. Simpson, City Engineer, Columbus, Ohio

The location and construction of street railway tracks in city streets creates a weakness in the pavement which is difficult to overcome. The mere presence of street railway tracks in a street has a tendency to cause the vehicular traffic to confine itself to fixed lanes, which increases the wear and adds considerably to the maintenance cost of the pavement outside of the track area over and above the cost on streets with similar traffic where there are no car tracks. The vibration in the track structure itself, caused by street car movement, not only affects the pavement in the track area, but is transmitted to the roadway pavement beyond.

In the construction of street railway tracks, in city streets, the most permanent type possible should be adopted in order to reduce to a minimum the weakness caused by their very presence in the street.

The sub-base for track construction should be thoroughly drained and unyielding. If necessary, a sub-base of concrete should be provided, in order to secure a firm base. In cities where an eight-inch concrete slab has been used as a sub-base, the results have



From the Road Builders' News

demonstrated its superiority over other types. Experience seems to indicate that, from the standpoint of paving surface, the best results can be obtained by the use of grooved rails, although some cities seem to be getting fairly good results with T-rails. With grooved rails it is much easier to secure and maintain a satisfactory paving surface since the pavement can be finished flush with the steel. With such construction the cross movement of traffic is greatly facilitated.

It is felt that the use of brick and stone block paving in the car tracks gives more satisfactory results than other types. The block type, with asphalt filler, is easily removed when it is necessary to make repairs to the rails and absorbs more readily the vibration set up by street car traffic.

Contracts and Specifications

Chairman, Dudley T. Corning, Chief of Bureau of Highways, Philadelphia, Pennsylvania

Specifications.—Cities do not, as a rule, adopt any so-called model specifications as a standard. There were four exceptions to this rule reported: Kansas City, Trenton, New Jersey, Seattle, Washington, Pocatello, Idaho. Two others report that the standardized specifications of the American Society for Testing materials and the American Society of Municipal Improvements have been used to some extent in the preparing of their specifications.

The specifications of most cities are built up as a result of the paving practice of that city, modified by ideas gathered from the many "so called" standard specifications which come in the daily mail of every city engineer. This is liable to lead to even greater confusion. Standard specifications can only be written after studying the requirements of many cities and the products offered by many manufacturers. Specifications to be standard must be universally acceptable.

It is probably true that specifications for the materials of construction are gradually being made to conform to some model which is universally recognized as a standard throughout the country.

Contract.—The contract procedure of any city is largely the result of years of practice under their basic laws. The financing, assessing, and accounting procedure for improvements depends upon the methods used in contracting for the improvement.

The survey indicates that a majority of the cities use a separate contract for each improvement, although there were very nearly as many who group several improvements under one contract. Of the latter class, there are Richmond, Virginia, which awards contracts grouping a number of streets of the same type together, and Portland, Oregon, which includes in the same contracts streets that may be in adjoining districts. Dayton recently changed its practice of awarding separate contracts to one of grouping a number of improvements in one contract.

The building of pavements by direct labor is reported by Worcester, Mass., and Wilmington, Delaware. Flint, Michigan, also builds many of its pavements by direct labor. This practice can be a success financially only when the city engineer is absolutely free to hire employees at rates of pay consistent with that paid by contractors on similar work, and otherwise carry on his construction work as a contractor must do to make a profit.

There is an almost universal acceptance of the practice of making contracts on a unit price basis. Buffalo was the only city reporting an exception to this.

A clause in the contract requiring the guaranteeing of the pavement finds favor in most of the surveyed cities. Only five of the municipalities who do their paving by contract do not require a guarantee. These are rather scattered geographically.

In most of the cases, the guarantee covers only defective workmanship and material, even though it is called a maintenance guarantee. A few cities report that their guarantee is a maintenance proposition and some report that it is both a guarantee against defective materials and a maintenance provision.

It is quite evident that much confusion exists in the minds of the engineers as to what a guarantee provision should cover and how the guarantee should be backed up.

Six of the surveyed cities specified cash deposit, two cash or bond, and the remainder a bond insuring the fulfillment of the guarantee obligation.

Subgrade and Pavement Bases

Chairman, Charles E. Reppert, City Engineer, Pittsburgh, Pa.

This committee presented a most complete survey on the subject of subgrades and bases. This survey indicates that more attention than ever before is being paid to these subjects. In regard to bases, city engineers are not building them thicker and stronger in order to carry the increasing loads, but are turning to ways and means for increasing the supporting power of the subgrades. Every city reporting recognized the importance of proper backfilling of trenches and cuts in the subgrade. Puddling of sand and gravel subgrades is general practice, as it aids in finding soft and uncompacted spots. Cushion blankets are also used to overcome the deficiencies of the subgrade. The usual thickness is 4 to 6 inches.

Two-thirds of the cities report using a 6-inch thick concrete base. It is the minimum thickness reported in 40 per cent of the cities: two cities report a 10-inch base.

Maintenance—Surfaces of All Types

Chairman, W. W. Mynatt, Director of Public Service, Knoxville, Tenn.

Regardless of the type of surfacing, adequate maintenance is absolutely necessary for the proper protection of the original investment and to secure the maximum service from the pavement constructed. Maintenance, therefore, presents a problem not only in finance but in efficient engineering and planning and most skillful workmanship. A small expenditure at the proper time will save many times that amount if needed work is deferred until some later date. Patching materials should be selected and prepared with the same care and precision as is used in construction work.

Maintenance—Street Openings or Cuts

Chairman, R. A. McGregor, Engr. in Charge of Maintenance, Borough of Manhattan, N. Y.

The greater percentage of openings are necessitated by the increasing demand for utilities by a grow-

ing population or by new requirements resulting from building construction and the opening of new territory. Delaying pavement restoration is useless and should follow the installation as soon as practicable. Deferred pavement restoration, high backfilling and neglected openings result in criticism and lack of confidence in the energy and capacity of the city government.

Cleaning of Streets

Chairman, A. Mason Harris, Chief, Bureau of Streets, Richmond, Va.

The principal factors governing the cleaning of streets are the character and quantity of street refuse, the character and condition of street paving, and the character and density of traffic.

Cleaning by cleaning equipment is cheaper and more efficient for the covering of large areas than the work of single men in definite sections.

Police action is the only method that will prevent the production of the vast quantity of litter deposited on the streets. Coordination between street cleaning organization and the police is vitally necessary.

Resurfacing and Salvaging of Pavements

Chairman, V. N. Taggett, City Engr., Niles, Mich.

By salvaging existing pavements, the existing subgrade stability and bearing power is not destroyed. The existing metal is reclaimed and its useful life is continued with a corresponding decrease in construction and maintenance costs.

In the greater percentage of instances, when drainage conditions are good and where there is ample subgrade stability, it is economical to utilize the old pavement material as a base for the new.

If failure is due to inadequate drainage or lack of subgrade strength, new pavement should be placed with adequate slab strength to provide for modern traffic loads.

By utilizing the old base and adding new material, greater thickness and strength result.

Unpaved Streets

Chairman, J. P. Broome, City Supervisor, Summit, New Jersey

Surfacing unpaved streets by low-cost bituminous applications saves maintenance costs and is an intermediate step in stage construction. Drainage and grading are of fundamental importance under any condition; without them all maintenance methods are expensive. A careful study of local materials is necessary to determine adaptability as a surfacing material.

Traffic Signals and Signs

Chairman, William S. Canning, Engineering Director, Keystone Automobile Club, Philadelphia, Pa.

A brief summarization of the recommended use of the various traffic control devices is as follows:

Warning signs should be used at unusual conditions of street layout or in outlying communities in advance of widely separated intersections, hospitals, schools, playgrounds and so forth.

Danger signs should be used where the hazard is positive and should be illuminated at night by reflecting devices, street lights or flood lights.

(a) Reflecting devices should be more generally used to emphasize at night-time a danger sign or a "Stop" sign.

(b) Pavement markings are recommended for use in the control of traffic lanes at intersections and as

advance warnings to major intersections or railroad grade crossings.

Flashing beacons are recommended for use where the hazard is permanent, to align traffic and as indications of a condition requiring reduction in speed.

"Stop" signs are recommended for the protection of high speed arterial highways where the volume of traffic on the intersecting street falls below 25 per cent of the volume of traffic on the through highway.

Isolated automatic lights are justified under certain conditions to insure pedestrian safety and to control isolated intersections where the volume of traffic approxi-

mates 1,200 vehicles per maximum hour with at least 25 per cent of the total on the lighter travelled street.

(a) Traffic demand signals are considered for isolated intersections not planned for inclusion in a general system at some later date where the traffic flow on the intersecting streets is irregular, the signals being actuated by the movement of vehicles toward the intersection and proportioning the "Go" time directly to the number of vehicles which approach the intersection from any direction.

Traffic officers: It is undesirable that traffic officers be continued at localities where signals are in operation because frequently more attention is paid by the vehicle operator to the officer than to the signal.

(a) Semaphores: Manual operation of semaphores by traffic officers is undesirable because of the tendency to make the officer mechanical and destroys his flexibility by fixing him in a given location.

(b) Hand signals: A traffic officer, when stationed at locations where street car or other turning movement is heavy, in conjunction with signals or without, can most effectively supervise traffic movement by hand or arm signals provided these signals are definite



From the Road Builders' News
Uncle Sam Visits the Road Show

and that all the officers are carefully trained in a uniform code of hand signals.

Complete automatic signalization: Based upon the volumes of traffic previously set out, complete automatic signalization of the "limited progressive" or "flexible progressive" type should be installed where it is desirable to co-ordinate properly the movement of traffic over a wide number of immediate adjacent intersections.

County Officials' Sessions

Papers and reports presented before this section of the convention were of unusual excellence. Abstracts or summaries of most of these are given herewith:

Legislation

Chairman, W. M. Connelly, County Road Commissioner, Grand Haven, Mich.

Federal aid should not extend to secondary or tributary roads, but be confined to primary roads. To carry federal aid much beyond the present seven per cent system would mean spreading it so thin that no practical benefits could result. It is claimed that there are 45,000 rural mail carriers using 1,270,746 miles of rural roads, practically all of which need improvement. County interest should favor larger federal appropriations for primary roads which would relieve the draft on the state funds and in turn work for the legislation that would secure a larger share of the motor vehicle license and gas tax fund for the counties. In a measure this might be considered indirect federal aid.

County road commissioners, engineers and superintendents should form state organizations. They should hold frequent meetings, have strong standing committees on legislation, and keep in close contact with their representatives at the Capitol.

Administration

Chairman, Charles A. Browne, Chief Engineer, Orange County, Orlando, Florida

A form of county road administration to secure best results was recommended as follows:

- A non-partisan county road commission of three members with six year terms to be selected by the county board or county court.
- This road commission to act as a board of directors to budget road funds, to determine matters of policy, and to appoint a county highway engineer and fix his salary.
- This engineer to be selected solely on the basis of his qualifications for the duties of the position, to be responsible to the commission for the execution of all road work. He shall in turn "hire and fire" those under him on the merit and duty performed with no interference in these matters by members of the commission.
- Term of office of the county engineer and his subordinates to be terminated not at stated intervals, but only on failure in the performance of duties.

The following administrative policies are urged as necessary:

- Systematic and constant attention to roads embraced in the county system.

- Careful and simple method of accounting to make readily available the actual expenditures on all roads even the least important.
- The gathering and use of suitable traffic data to determine traffic needs and as a primary guide in controlling the allocation of funds and the type of improvement.
- A decided emphasis on the use for secondary roads of the knowledge recently made available in low cost road methods.

Finance

Report Presented by Thomas S. Stevenson, Secretary, Pennsylvania Rural Roads Assn.

Equitable and adequate financing of county highways is probably one of the greatest problems before state and local administrators. A fair distribution of the cost of providing highway service in proportion to the benefits derived constitutes the general problem.

Benefits accrue in four ways: national benefit by providing for free flow of traffic between states and by provision for national defense; general benefit to community life; special benefit to abutting property, and benefit to the individual user of the roads. The question is in what ratio should funds be allocated among the through traffic highways, the community roads, the purely local roads and the municipal streets.

The gasoline tax is probably the most equitable tax ever devised for highway purposes, in that each person pays in the same ratio that use is made of the road. However, with increase in rates a tendency has developed to divert portions of the proceeds away from highway funds to other state purposes. This tendency should be curbed at once.

General Committee No. 3 on "Design and Construction" of the County Highway Officials' Division, of which the general chairman was C. E. Burleson, County Engineer of Pinellas County, Fla., received reports from four subcommittees, as follows:

General Design as to Location, Grading and Drainage

Chairman, W. O. Washington, County Engineer, Cameron County, Texas

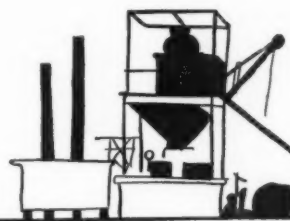
Principally because of the distinct increase in motor-vehicle speeds in recent years, the report indicated, for the purpose of safety, the necessity of locating highways as nearly straight, and as nearly level and smooth as is possible. It also enumerated the allowable departures from these ideal conditions that affect such details as right-of-way, roadway, surface, and shoulder widths; sight distances on horizontal and vertical curves; maximum and ruling grades; allowable maximum curvature; compensation of grades for curvature; superelevation and widening of curves; allowable distance between reverse curves; crown and smoothness of surface; railroad-highway and intersecting-highway grade-separations; and the necessity for such features as guard rails and danger, warning and informational signs.

The report also indicated the desirability of designing the earth work so as to maintain the construction equipment at a minimum and recommended certain details of bridge and culvert construction which are believed to be essential in order to obtain the best results.

Plans, Specifications and Construction of Untreated Surfaces

Chairman, C. W. Deterding, Jr., County Engineer, Sacramento County, Calif.

This report indicated the universal necessity for the preparation of a smooth, traffic-compacted subbase, the desirability of placing the granular untreated surfaces such as sand, gravel, etc., in relatively thin, traffic-bound layers, the advisability of restricting the size of the surface rock to a maximum of 1 inch in diameter and preferably to $\frac{3}{4}$ of an inch; the most recent tests for determining the adequacy of sand clay or topsoil as a surfacing material; the logical selection of the feather-edge or uniform-thickness cross section; the function of traffic and the blade grader in order to obtain the best compaction and the smoothest surface; the allowable percentage of clay as a binder in gravel surfaces; the permissible softness or hardness of aggregates for untreated surfaces; the superiority of crushed gravel to screened and waterworn gravel; the proper depth of surfacing and the allowable crown; and the need for continuous maintenance in order to provide a smooth surface free from corrugations, "chatter" bumps, pot holes, ruts, etc.



From the Road Builders' News
Latin America Visits the Show

Plans, Specifications and Construction of Surface Treatment

Chairman, W. E. Duckett, County Engineer, Hennepin County, Minnesota.

This report includes the bituminous surface treatments, throughout the country, that are considered as intermediate types in the stage-construction process, between the untreated low-cost surface and the high-type pavements. In general, the report is limited to surfaces which cost less than \$6,000 per mile, although surfaces costing more than this have been included so as to indicate more clearly the line of demarcation between the intermediate and high types. The classification and description of the types is taken largely from the "Report of Investigation of Low-Cost Roads" by C. N. Conner.

The report describes distinctive methods and materials of construction, segregates the intermediate bituminous surface treatment into general types, and gives cost data per 18 feet width of varying depths for these types.

Plans, Specifications and Construction of Pavements

Chairman, G. S. Chaney, County Road and Bridge Engineer, Washington County, Pa.

The report outlines and gives brief conclusions of the latest developments in high-type-pavement design and construction. The following subjects are considered: Increased smoothness of surface for high-speed traffic; weight measurement of aggregates to obtain more uniform concrete; allowable decreased

thickness of brick surfaces; the stability test for bituminous surfaces; the use of the mechanical finisher to obtain a higher degree of surface smoothness; the demand for high-early-strength Portland cement; the minimum mixing period for concrete; the subgrade and subbase as important factors in the design of the surface; representative cross sections for pavement design; the improvement of concrete-pavement curing methods; concrete pavement joints; better control of construction operations; and the growing importance of the water-cement ratio.

General Committee No. 4, of which Hal G. Sours, County Engineer of Summit County, Ohio, was chairman, presented a general report on "Maintenance." This subject was divided between seven sub-committees, as follows:

Shoulders and Drains

Chairman, H. B. Keasby, County Engineer, Salem County, N. J.

The growing demand for more beautiful road-sides often can be at-

tained by relatively inexpensive means. A stand of grass affords a practical and efficient means of protection and beautification. Mowing and weeding of right-of-ways is important and necessary.

Higher speeds of motor vehicles make more substantial shoulders necessary; these are often constructed of stone, gravel or slag and must be maintained.

The slips and slides that damage roadbeds in some localities can be avoided by proper location or stopped by extensive drainage or piling or the use of explosives.

Erosion is best prevented by the seeding of slopes, or the diversion of water from surfaces subject to wash by means of pipes, paved gutters, or raised curbs.

Tile drains are effective under certain conditions of soil in protecting sidehill fills and strengthening subgrades.

The maintenance of shoulders and ditches with machinery is coming more and more into vogue, due to the development of suitable equipment and the high cost of hand labor.

Surface Treatment

Chairman, J. T. Bullen, Parish Engineer, Caddo Parish, La.

The conclusions and indications from this paper are: An efficient maintenance organization in shape to give immediate and constant attention is necessary to the success of the bituminous surfacing of low cost types.

Under certain conditions of surface and traffic the use of calcium chloride justifies itself in the saving of material and elimination of dust.

A thorough and uniform mixture of bitumen and aggregate by blading back and forth is most important feature of the mixed-in-place method.

It is poor economy in general to treat less than 18 feet in width or where the road metal is of sufficient thickness to carry over the winter or rainy season.

Blading with long wheel base graders and particularly the use of long heavy drags or planers is the big factor in eliminating bumps and securing smoothness.

The use of too much bituminous material particularly where the proportion of fines is high will cause shoving.

Hard clean large size cover depending on nature of bituminous material gives better results than fine aggregate for cover.

Bitumens of low viscosity are better for first applications. Tars seem to be preferred in more localities than asphalts for that purpose.

The tendency is to use bitumens of higher viscosity, tars or asphalts for the second or third application.

The improvement in methods in recent years securing dustless smooth riding surfaces at small cost has brought great popular support for this sort of work.

Untreated Surfaces

*Chairman, R. C. Hill, County Engineer,
Sussex County, Del.*

This report outlines some of the important facts regarding the maintenance of untreated surfaces, except ordinary earth roads which are not discussed. Among the points covered are: Size of material, amount of material, advantage of a flat crown, replacement, quality of material, maintenance methods, blading and dragging, and equipment therefor.

Pavements

*Chairman S. A. Green, County Roads Engineer,
Baltimore County, Md.*

The best way to get smooth pavements is to build them smooth in original construction. This is particularly true of rigid types. The use of transverse contraction joints seems to offer possibilities for reducing the cost of crack and joint repair in addition to preserving the good appearance of concrete pavements.

Good judgment as to the proper time "to surface treat or not to surface treat" bituminous macadam pavements is a big factor in the economic maintenance of this type.

It is important that the operations of road pavement maintenance be so shaped as to accommodate the traveling public rather than the public be inconvenienced to make repair work easier. The use of high early strength concrete and in some cases bituminous materials for the repair of rigid pavements by reducing the time surfaces must be blocked off often helps carry out this policy.

With the great increase in the volume of maintenance work now taking place, economy of funds will be promoted by fostering the extension of the contract system.

Equipment

*Chairman, E. L. Gates, Co. Supt. of Highways,
DuPage County, Ill.*

This report states that the motor patrol grader shows considerable economy over teams, and that trucks almost without exception will do the hauling cheaper than teams.

For the production and hauling of materials the

contract system will generally prove more economical than the purchase of equipment and operation by county officials. Expensive equipment should not be purchased unless it will work sufficient days in the year to more than pay for itself.

Neither trucks or rollers should be used as tractors. The trend is toward the use of heavier tractors with greater power entailing larger and stronger road graders. Tractors of the wheel type are more economical under good road conditions but track-type tractors are more capable of performing under bad conditions.

Equipment for narrow county and township roads is limited as to width both on account of traffic and narrow bridges.

Frequent inspection in the field by a competent traveling mechanic is one way to get the most out of equipment; another is the enforcement of the policy of having one man only operate the same machine, and another is the practice of greasing and inspecting at the end of each day's work.

Snow Removal

*Chairman, R. Wolfangle, County Engineer,
Ramsey County, Minn.*

The most efficient way to provide "open roads for winter traffic" is to use means for preventing snow drifts on the road. This may well be accomplished by the use of snow fence, which is a very practical method for keeping drifts off the road. Cutting weeds and brush, removal of heavy gates, etc., each fall also simplifies snow-removal work.

High speed trucks equipped with straight blade plows furnish the best means of removing medium falls of snow. The best practice is to clean the full width of the surfaced roadway and part of the shoulders for future storage and drainage.

Heavy snow removal equipment is undergoing rapid development.

Signs and Guard Rails

*Chairman, George C. Wright, County Superintendent
of Highways, Monroe County, N. Y.*

On the subject of road signs a brief description of the standard warning signs now in use by many states is given. Their use by counties is advocated. Some space is given to the matter of advertising signs on highways and the steps some states have taken to eliminate or regulate them. The latest developments in materials used for warning signs and route markers and the cost of same are also outlined.

Rough topography demands a strong fence to hold the vehicle on the road. Steel wire cables offset from wood posts are providing satisfactory protection for these conditions, but a common fault is the use of too few or the incorrect installation of clips.

On tangents, particularly in level country where vehicles strike the rail at an acute angle while at high speed, a deflecting surface at hub height such as is furnished by a heavy plank or other smooth surface has given good service.

Light wooden rail should no longer be erected.

Country Highway and Airport Pavement

Geo. C. Warren, Warren Brothers Co., Boston, Mass.

In presenting a resume of highways in this country over the period from 1893 to 1930, Mr. Warren dis-

cussed the history of the development of road construction and road surfaces, particularly the bituminous pavements. He also stated that airport pavements will require highly improved types of construction, in the near future, as compared to the present "shoddy" types.

Highway Contractors' Sessions

At the first meeting of this section, a number of papers of interest to contractors were presented.

The Report of the Committee on "A Study of Liens in Public Construction," prepared by its chairman, A. E. Horst, secretary and treasurer of the Henry W. Horst Co., of Philadelphia, Pa., was read by S. M. Williams.

The report is ready for printing except for a minor amount of editing and it will contain about 390 printed pages. It will include: A brief history of committee activities; a copy of the 1929 report; presentation of laws of all states and District of Columbia; comments by the U. S. Department of Commerce.

"Is Prequalification of Bidders a Success?" was presented by L. I. Hewes, deputy chief engineer of the U. S. Bureau of Public Roads, San Francisco, Cal., and Charles H. Buckius, construction engineer, Pennsylvania department of Highways, Harrisburg, Pa.

"American Contractors in Foreign Countries, With Special Reference to Latin America," was read by R. W. Hebard, president of R. W. Hebard & Co., New York, N. Y.

The problems and difficulties of road building are measurably magnified and accentuated in the foreign field, and the uncertainties exist there in a greater measure than in the United States. That this is true is due in part to the fact that the operations of an active company may be, and frequently are, extended simultaneously over half a dozen or even a dozen separate countries. A popular belief is that all of the Latin American republics, and there are twenty, are more or less the same. This is, on the whole, fallacious. The republics of Central and South America and the West Indies, are, it is true, more or less identical in historic origin, language and religion, and with certain similarity in racial origin, but this resemblance by and large stops at this point. Conditions met with in contracting for example, in Mexico and Panama, or the Argentine and Costa Rica, are widely

different; distinct forms of government, political situations and presidents with greatly varying degrees of power are unmistakably evident throughout the length and breadth of Spanish America. Variations in characteristics of the people themselves are common. A wide range of different kinds of topography and climate are met. Labor conditions naturally differ greatly even between neighboring republics.

Labor is cheap, earning in most countries less than one dollar per day. Its efficiency differs widely between countries.

It is then necessary that the contractor and his staff adjust themselves to these widely divergent situations and conditions, and their adaptability in this respect is an important factor in such degree of success as may be attained.

"A Survey in the 48 States of Weather Conditions, Working Days, Bonus and Penalty Requirements," compiled by C. N. Connor, engineer-executive of the American Road Builders' Association, and P. F. Seward, assistant engineer, was presented to the highway contractors. In this paper it was pointed out that approximately two years ago the American Road Builders' Association began the collection and tabulation of data on average weather conditions, working days and bonus and penalty clauses throughout the United States.

Information was given regarding the requirements of the various states on the penalty and bonus

clause and data on weather conditions which may be used by the contractor in planning work in other states than those in which he is accustomed to operate.

Subgrades and Pavement Bases

This report was presented by James S. Burch, jr., assistant engineer of the Association. In its preparation he had the assistance of a number of prominent engineers, among them A. C. Benkelman, J. T. Bullen, R. W. Crum, F. H. Eno, A. T. Goldbeck, F. V. Reagal and George B. Sowers. The report, which occupies 45 closely written pages, is very complete. The summary is as follows:

At present the studies in soils and subgrades have not reached the point where a mathematically exact table or formula may be prescribed as a basis for design of pavements. Such a procedure may never

Public Works Outlay for 1930 Put at 7 Billion.

Complete reports from the Governors of twenty-six States indicate probable expenditures of \$1,778,742,901 for public works, and this combined with conservative estimates based on partial returns from the remaining 22 States aggregating \$1,275,000,000 it was stated, would give the indicated total of \$3,053,742,901 for public construction by the various States. Private construction is estimated as in excess of \$3,000,000,000.

The estimates by the Governors of twenty-six States of public construction for 1930 are as follows:

State and Governor.	Estimated.
Arkansas, Harvey Parnell.....	\$35,178,650
California, C. C. Young	202,230,123
Connecticut, John H. Trumbull....	40,000,000
Delaware, Clayton D. Buck.....	8,000,000
Florida, D. E. Carlton	19,483,366
Idaho, H. C. Baldridge	8,100,000
Kansas, Clyde H. Reed.....	46,104,561
Maine, Wm. T. Gardiner	18,000,000
Massachusetts, Frank C. Allen	105,460,000
Missouri, Henry S. Caulfield.....	67,415,759
Montana, John E. Erickson	11,500,000
Nebraska, Arthur J. Weaver	32,000,000
N. Hampshire, Charles W. Toby....	6,750,000
New Mexico, Richard C. Dillon....	7,000,000
New York, Franklin D. Roosevelt...	475,275,442
North Carolina, O. Max Gardner...	36,000,000
North Dakota, George F. Shafer...	7,000,000
Ohio, Myers Y. Cooper.....	233,225,000
Oregon, A. W. Norblad.....	29,500,000
So. Carolina, John G. Richardson...	33,000,000
Texas, Dan Moody.....	180,000,000
Virginia, Henry Flood Byrd.....	41,000,000
Washington, Roland H. Hartley...	37,000,000
West Virginia, W. G. Conley.....	33,000,000
Wisconsin, Walter J. Kohler.....	61,430,000
Wyoming, Frank C. Emerson.....	5,090,000
Total	\$1,778,742,901

be possible, but research efforts are being directed toward that objective. At present, however, a knowledge of subgrade types and properties already developed is very valuable in indicating the most successful pavement design for given subgrade conditions.

The results of research and principles of design should not be blindly applied to highway construction, but all the existing variables and conditions should be considered by an able highway engineer to obtain the greatest benefits.

In areas where soils are stratified and exist in thin layers it is indicated the exact soil analysis is so tedious as to become impractical. In these areas, however, the different strata combinations follow fairly similar trends and it may be possible to classify the soils according to profiles and zones similar to the Bureau of Soils method. This method supplemented by check tests on soil properties appear most promising for a subgrade identification in those areas.

The road and street requirements for future traffic are difficult to forecast. It seems to be conceded that the quality of our highways cannot be decreased and a factor of safety in base design for future traffic requirements appears advisable. It is an established fact that any improvement which will lengthen the serviceable life of a given highway is justified provided the additional life compensates in service for the cost of the improvement.

Subgrade improvement and improvement in base design when properly applied will undoubtedly increase the life of our highways to the extent that the increased cost will be justified.

Standardization of Methods for Purchasing Equipment

Chairman, W. A. Van Duzer, Assistant Chief Engineer, Pennsylvania Department of Highways.

The committee covered many details connected with equipment purchase in the compilation of this report. The recommendations are the result of an analysis of present practice in forty-seven states, and conclusions reached by the joint committee from close individual observation.

The report gives first a summary of facts secured through questionnaires, regarding state laws governing equipment purchase, and also a summarization of data pertaining to methods of equipment purchase. Second, it includes recommendations of the states as indicated in the summary of the questionnaire, and third, it gives the recommendations of the committee as they were discussed and formally adopted. The supporting data on which the summary is based are included. But recommendations are made only on a part of these data. This is because time for a scrutinizing study of the balance was not available.

Sewerage Deficiency in Chicago

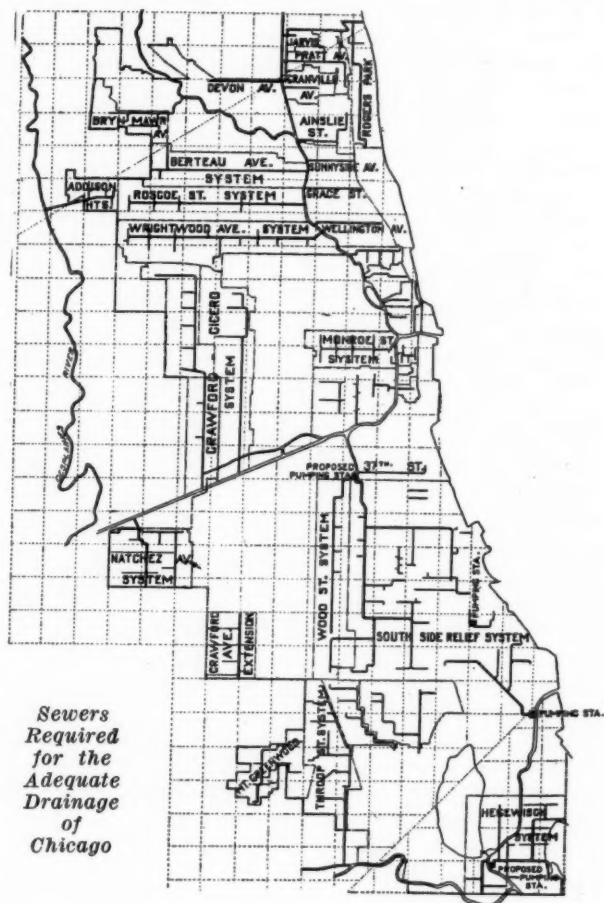
According to the latest annual report of the Bureau of Sewers of the Chicago Department of Public Works, of the 210 square miles of that city about 27 square miles had not yet been sewered; and of the remaining 183 square miles, about 127 square miles was inadequately sewered and required relief. The sewers in this 127 square miles have but 20% to 40% of the necessary capacity and are inadequate for the disposal of rainstorms of more than ordinary intensity. This inadequate capacity causes repeated flooding of basements and other low-lying places and, as these sewers are combined sewers, this flood water carries sanitary sewage with it. In some districts these floods occur as often as five or six times a year. In some parts of the city sewage is discharged during storms from sewer manholes onto the streets, and this would occur more frequently did not the basements of the city buildings furnish sufficient storage for the sewage until the sewers are able to carry it off.

This condition has prevailed for a number of years. During the past 16 years several relief sewer systems had been built, giving relief to an area of some 10,000 acres. Other relief sewers have been planned to relieve a total of about 7,100 acres, while others are being built to relieve about 13,000 additional acres. The cost of the twelve systems planned would total about \$17,500,000. To meet the requirement for additional sewers and relief sewers would cost about \$100,000,000.

On January 1, 1929, there were in use in the city 805 miles of brick and concrete sewers and 2,308 miles of vitrified pipe sewers; with which were connected 115,444 manholes and 164,420 catch basins.

During the year about 10,000,000 feet of sewers were flushed, about 1,000,000 feet of sewers were scraped, there were 31,000 cleanings of catch basins by machine and 62,000 by hand. The unit cost of

flushing was \$7.51 per 1,000 lineal feet; scraping, \$12.59 per hundred lineal feet; and cleaning catch basins cost \$2.45 by machine and \$3.84 by hand. Of the cost of machine cleaning, about 81% was for wages, 6½% for repairs, 5% for supplies, and 7½% for interest and depreciation.



THE EDITOR'S PAGE

Use of Patented Pavements

There seems to be a tendency inherent in engineers, and especially those engaged in highway work, to avoid even the consideration of use of patented materials in work under their charge. They use patented automobiles, trucks and other road-making machinery, pumps and other aids to construction, but patented materials seem to be taboo. This we believe to be unfortunate for all concerned, and the reasons for this attitude of mind are worth serious consideration.

At least four such reasons suggest themselves as influencing different engineers in different degrees: Timidity, economy, dread of suspicion of graft, and mistaken ideas concerning professional ethics.

The first is perhaps the most general. Too many engineers are controlled in their professional conduct largely by precedent. They employ only those methods and materials which have been endorsed by other engineers—it saves them the trouble of independent investigation, and avoids reliance upon their own judgment based upon their knowledge of the technical points involved, concerning the reliability of both of which they may have private doubts. Or perhaps they are just plain too lazy to adapt their practice to new ideas when the old seem to be fairly satisfactory.

There are a number of patented paving materials on the market which represent the expenditure of much research and money on the part of the developers and merit at least an attitude of open-mindedness on the part of engineers but fail to receive it from most of them. The claims of the advocates are of course only claims, and their arguments are naturally prejudiced; but if they seem to indicate characteristics valuable for the project under consideration, not only fairness to the promoters but duty to the engineers' clients dictate a serious and unbiased study of the claims and arguments.

And this leads to the next cause for aversion to patented materials—economy. If an unpatented material, on which no one collects a royalty, will serve the purpose, why pay the additional royalty? The answer is that the additional cost may be more than offset by better service, longer life, lower maintenance cost, and other advantages; or there may be no additional cost. This is a matter to be settled by careful calculation and not by off-hand assumption.

As to graft; there was, some years ago, a practice among some promoters of paving materials—not all of them patented—of securing the adoption of their materials by canvassing taxpayers, buying the approval of local papers (and perhaps of some engineers) and the votes of councilmen, until many honest men avoided approving even those materials which they believed to be excellent. Fortunately there has been little of these practices of recent years, and an honest engineer can approve a paving material and still be free of any suspicion of evil.

As to professional ethics, this might apply to the advocacy by an engineer of a material or method on which he himself would collect a royalty or otherwise

profit financially, but we can see no violation of ethics in adopting a meritorious material even though the investigator and patentee who receives a small percentage of the cost be a technical man.

A more fair and open-minded treatment of these pioneers who are bringing a wide experience to the problem and are spending their own money in research, trial and development would, it seems to us, hasten the development of new types of road surfaces, better fitted to serve and endure under the severe demands of modern traffic.

Discrimination Against P. H. S. Engineers

At the present time there is only one Senior Engineer in the U. S. Public Health Service, though by virtue of standing in their profession and length of service, there are a number of men who would qualify for this rank.

In the Bureau of Public Roads, in the Mississippi River Commission, in the Engineer Department, and in numerous other governmental departments, senior engineers are numerous. In the 2nd New Orleans District of the Mississippi River Commission alone, there are five senior engineers.

The blame for this rank injustice to the men of the Public Health Service cannot be placed entirely on the officials of the Public Health Service. Except in rare cases, they themselves cannot advance to a higher corresponding rank, though men in corresponding grades in the Army and Navy do so practically automatically.

There is a bill now before Congress which would remedy this condition, and make it possible for the men in the Public Health Service, both engineers and doctors, to advance as men in other governmental departments do. It ought to be passed. It is decidedly unfair to these men to close the door to further advancement in their profession and in salary after fifteen or twenty years of service.

A Satisfactory Road Show

The 1930 Road Show is now history, but it set new marks in a number of ways. The technical sessions were a great improvement over those of preceding years. The machinery of the convention operated with precision and smoothness. The attendance, while no greater than, if as great as, previous shows, was of excellent quality, and nearly all the exhibitors reported complete satisfaction.

The new president is W. A. Van Duzer, whom we regard as one of the most able men in the road building industry. It is, however, the good fortune of the American Road Builders' Association, that even without such a man as Mr. Van Duzer at its head, it would not lack able direction. Charles M. Upham and C. N. Conner have amply demonstrated again their very great and unquestioned talents as director and executive of the association.

City Engineering at Syracuse

In his report for the year 1929, Nelson F. Pitts, Jr., city engineer of Syracuse, N. Y., describes many features of the functioning of the engineering department during the year which are of general interest. The work of the department included street improvement, sewer construction and extension, public buildings, water supply, sidewalks and grading, surveying and mapping, house numbering, photography, and records and accounting.

Mr. Pitts stated that "Previous to letting any contract this year, the specifications for all public works were revised and brought up to date with the best standard practice governing construction work. With the co-operation of the Civil Service Commission, the qualifications for the position of inspector of public works were made more rigid than in previous years, with the result that a better class of men were secured to supervise construction work. Meetings of inspectors were held at regular intervals for the purpose of instructing them in the duties of their position and to keep them informed of changes in engineering standards applicable to their particular work."

STREET IMPROVEMENT

In laying out and improving streets, 34 feet was considered the least width of roadway in which two lanes of traffic can conveniently traverse a street with cars parked along each curb. In fact, this width is used only when it is impossible for conditions on the street to accommodate a 36-foot width. In accordance with a decision of the administration made last year, the cost of all pavement over a width of 27 feet was made a general city charge.

Previous to letting any contracts this year a stipulation was made in the specifications to the effect that all pavements would be tested by drilling cores therefrom; these to be measured to determine whether or not the pavement was laid to the required depth, and also subjected to a compression test to determine if the required strength had been developed in the concrete base. Also, more particular methods of grading and handling concrete materials were indicated, and the specifications for the surface materials were changed to insure the best quality of materials and workmanship.

On account of these changes, requiring more care in workmanship and the selection of materials, it was expected that there would be some rise in paving prices. There was an increase in the first paving bids received, as had been expected; but when bids were received at the second letting, a further increase in prices was found which was thought by the engineers to be excessive and these bids were rejected and the work readvertised. Bids received after the re-advertisement were lower than any previously offered during 1929 and subsequently have continued at the lower level of prices, vindicating the policy of the administration in rejecting the first bids on the second letting. The average cost of asphalt pavement during 1929 was about \$2.80 per square yard, a figure which compared favorably with prices of the past several years.

One street which had been paved with concrete years ago passed between high banks from which water overflowed onto the surface of the roadway or

seeped through the ground under the pavement, causing disintegration of the concrete. To remedy this condition, a drainage trench was dug along the toe of the bank and vitrified pipe with open joints was laid along the bottom of the trench and properly connected to existing catch-basins, this pipe being covered with broken stone to an average depth of about 4½ feet, which stone was covered with a concrete gutter to convey surface water to the catch-basins. The old concrete pavement was then covered with sheet asphalt.

WATER SUPPLY

The division of water supply in past years has performed some of the smaller jobs of extending the distribution system with its own forces, letting out the larger projects to contractors. In 1929, due to the purchase of equipment capable of handling the larger undertakings, the division was able to perform a large part of the distribution extension work itself, in addition to building the intake and outlet of a new reservoir. One of the jobs which it performed was the laying of a 42-inch cast-iron intake feeder to Knapp reservoir for a distance of about 4,500 feet. The division used a 1¼-yard Browning trench-hoe, purchased for this purpose and for future work of the same kind. The line of the conduit was just west of a concrete pavement, traffic on which was heavy, and this, coupled with the existence of trees, fences and other structures near the work, made the installation rather difficult at times. However, the pipe was laid with very little damage to trees on adjoining property and the traffic was maintained on the highway throughout the job except for one day. In excavating for the pipe, a large amount of rock and hard-pan was encountered, the removal of which delayed the work to some extent.



LAYING 42-INCH FEEDER TO KNAPP RESERVOIR

Asphaltic Treatment of Sand-Clay Roads

How Reno County, Kansas, used oil in a mixed-in-place stage construction to improve dry and wet weather conditions.

By W. A. Stacey*

County roads in Kansas are farm-to-market roads and ordinarily second to state highways in importance. Usually, less money is available for their improvement and the surfaces placed on these roads must be inexpensive.

In Reno county, Kansas, nearly all of the county highways have a sandy-clay surface. This is in part due to the natural sand and clay composition of the soil in one third of the county. In the second third of the county the soil is gumbo, and this surface is produced on it by windrowing 500 to 600 cubic yards of graded sand per mile on the shoulder of the completed road and working this into the road by blading and by the action of the traffic. The soil in the remainder of the county is too sandy to form a crust under the traffic and must have clay mixed with it to produce this surface.

The wearing surface thus obtained is an improvement over the ordinary earth road but has several glaring defects. In dry weather it is dusty and in wet weather it becomes choppy or corduroyed. The rather high winds common to this open prairie country cause a considerable annual loss of material from the surface. The road must be bladed every few days in order to keep it smooth. The maintenance per mile per year of this type of surface will usually run from \$300 to \$600 in this state.

In an effort to produce a cheap roadway surface superior to that of the sand-clay road, Reno county has this year started on a program of asphalt oil treatment of its main traveled highways. Some experimental work was done in 1928, and during July and August, 1929, 3½ miles of road was given two applications of a road oil containing 55% of bitumen, each application being at the rate of about 0.5 gallon per square yard. On our standard road bed of 30 feet, a width of 24 feet was treated.

*County engineer, Reno County, Kansas.

This work was done in the following manner: The surface to be treated was bladed as smooth and as free from dust as possible. This surface was practically all dry; however, we found that a slight dampness was not detrimental. Traffic was detoured and the oil was applied at once, heated to a temperature of about 125 degrees F.

About 15 minutes was allowed for the oil to penetrate what dust was left on the surface and to waterproof the road crust. Then about 15 pounds of sand per square yard was spread on the road to take up the excess oil. For several hours thereafter the surface was dragged to mix the oil and sand together, and then traffic was turned back on the road.

Dragging was continued for several hours each day for about ten days. By that time enough of the volatile portion of the oil had evaporated that an asphaltic mat was formed on the surface.

A second treatment, put on one month later, was identical with the first except that about 35 pounds of sand per square yard was required to take up the oil. In addition to the drag, a light blade maintainer was used, as the mat had now increased to one inch thick.

The surface thus obtained resembles sheet asphalt. A typical analysis of a sample taken recently is as follows:

Total bitumen	9.0%
Passing ¼" screen, retained on No. 10	10.4
" No. 20 " " " No. 20	10.0
" No. 30 " " " No. 30	12.4
" No. 40 " " " No. 40	11.4
" No. 50 " " " No. 50	15.5
" No. 60 " " " No. 60	17.1
" No. 80 " " " No. 80	3.2
" No. 100 " " " No. 100	6.0
" No. 200 " " " No. 200	5.0
	100.0%

The surface is dustless and waterproof and except



MAKING SECOND APPLICATION, COVERING OIL FROM SAND PILES ON SHOULDER

for a few places of unstable subgrade has remained smooth. These places are occasionally bladed in warm weather to improve their riding quality. Just before the next treatment is applied, they will be scarified, pulverized and bladed smooth again. After several more treatments, we expect these places to consolidate and give no further trouble.

For several years hereafter we expect to give this road one treatment of 1-3 of a gallon per square yard each year, and then cut it to only one such application over two years. The total cost of the two treatments this year was about \$1700 per mile. The cost of the oil was 6 cents per gallon f. o. b. our switch and the contract cost of the distribution was 2.5 cents per gallon. Sand, spreading and processing made up the remainder of the cost.

In the program laid out for this county, the asphalt oil treatment is to be placed on a road only after the grade and structures have been brought to a standard and all drainage problems worked out. A very much

larger mileage will be treated in 1930 than in 1929.

The method we are following is in reality a mixed-in-place stage construction to be prorated over a period of 4 or 5 years. Results so far indicate that maintenance costs will steadily decrease each year as we go along and that the total cost at the end of the construction period will approximate that which would have obtained had the construction been completed in one season. In the meantime, our usual county road traffic of 200 to 1000 vehicles per day will have been served by a good "all weather" riding surface.



PHOTOGRAPH TAKEN FIVE DAYS AFTER TREATMENT. MAT BEGINNING TO CONSOLIDATE

Prequalification of Bidders on Public Works

A comprehensive presentation of this subject by Philip A. Beatty, in which the author explained why he favored prequalification, was published in the October issue of PUBLIC WORKS. Subsequent to this, David C. Boswell, borough engineer of Bergenfield, N. J., brought to our attention a discussion before the Municipal Engineers' Association of the State League of New Jersey Municipalities, on "the use of the questionnaire in order to determine the qualifications of a prospective bidder;" during which discussion Mr. Boswell explained quite fully why he is opposed to the idea of prequalification. He has prepared an abstract of his discussion, which we present below. He also sent a copy of his discussion to Mr. Beatty, who has accepted his invitation to comment upon it, this comment also being given below. We are glad to be able to give our readers the arguments pro and con on this subject which is now receiving so much attention from contractors and engineers on public work.

ABSTRACT OF DISCUSSION BY DAVID C. BOSWELL

There has been considerable discussion among engineers and the press regarding a law in New Jersey permitting the prequalification through the use of a questionnaire submitted to contractors desirous of securing plans to bid on public work.

It might be well to add an explanation at this point as to the meaning of "prequalification" and "postqualification" of contractors.

"Prequalification" of contractors is the action of qualifying said contractors before they are presented with plans and bids are received.

"Postqualification" is the qualifying of contractors after the bids are received so as to determine the lowest responsible bidder.

Prequalification is far inferior to postqualification as a guide to contract bond underwriters because prequalification omits the most important factor in contract bond underwriting, and that is the adequacy of the contract prices. It is only after bids have been opened that surety underwriters can make an aggregate estimate of the probable success or failure of a contractor on any extensive piece of work.

Authority for Use of Questionnaire.—Chapter 180 New Jersey Laws of 1926 makes it lawful for any "officer, board, commission, committee or department or other branch of any municipal government . . . to require from any person proposing to bid on public work duly advertised a standard form of questionnaire and financial statement containing a complete statement of the person's financial ability and experience in performing public work before furnishing such person with plans and specifications for the proposed work duly advertised."

This extraordinary statute seems to be designed to shut out competitive bidding for public work and therefore to make such work more costly to the taxpayer. The design of competitive bidding on public work is to invite as many responsible contractors as possible to estimate on the work, so as to get it done as cheaply as possible and save money for the public treasury. The old contracting firms are constantly passing out of the picture and their places must be taken by new firms containing new blood and new money. This statute would shut them out from lack of "experience."

It is my opinion that if a state or a political subdivision of a state enacts any law or establishes a practice which permits any state or municipal officer to pass upon a contractor's qualifications to do a job

before they will give to a contractor the plans and specifications for the work, a vicious practice will have been established. State or municipal officers, including engineers who have charge of contract work, may be particularly skilled in relation to their own profession but their skill does not extend in very many cases to the extent that they will be in a position to pass justly on the question as to whether a contractor, after obtaining the plans and specifications in order to make a bid, will be able to do the work satisfactorily and give a bond guaranteeing the performance of the contract. To establish such a practice is unamerican in spirit, particularly with municipal work. Each person stands equally before the law and is entitled to engage in any lawful business. If one is not able to procure plans and specifications he certainly will not be able to make a bid for the work; and what state and political subdivisions are interested in, is to have the work done satisfactorily according to plans and specifications at the lowest price. This means free competition and equality before the law. After the bids have been received, then is the time to pass upon the responsibility of a contractor and the time to judge to whom the work shall be awarded. To do otherwise is to place a bar which will suppress competition.

To require a contractor to measure up a standard questionnaire and financial statement for the purpose of obtaining plans and specifications is not acting for the best interests of the citizens. Any law or ordinance permitting that practice is vicious because it attempts to establish a class legislation at an improper time.

Unnecessary and Unconstitutional.—I further believe it is unnecessary. Every bidder has to furnish cash or a certified check with his bid, to be applied to any loss sustained if he does not sign up. He has to furnish a bid bond to further secure a municipality. If successful, he has to furnish an approved contract bond, and often again after that a maintenance bond. With all this security all the way through, there can surely be no occasion to pry into his bank balances, notes, real estate or other personal matters.

Furthermore, it is a delegation of delegated authority and so unconstitutional. Local municipalities are operated by some sort of a governing body. This body gets its authority from the state by specific laws. Now comes the questionnaire act and places discretion in an employee of the governing body. There is recourse to the courts open against any unfair act of the governing body, but until the Supreme Court rules directly on this questionnaire act there is no review of the engineer's refusal to deal with all contractors equally.

If, however, the engineer shows the questionnaire to others, then every contractor's affairs are exposed to a degree, and often get to his competitors whether he bids or not.

The most vicious forms are the ones gradually slipping into some towns which compel a bidder to name his materialman or even get a letter from him to the effect that he will furnish the materials.

It is the contention of some engineers that the bonding companies are not affording the required protection and for that reason these engineers feel that they are obliged to go into a man's financial condition, experience and ability and take it upon themselves to

pass upon a contractor's responsibility, determined through the answers to certain questions in the questionnaire; and if the engineers are not satisfied with the sufficiency of the answers they will refuse him the right to receive a set of plans and bid on the work, even though the bonding companies are satisfied with him and are willing to give a bid bond and support him financially on said work.

I am personally satisfied with the protection afforded by the bonding companies and do not feel the questionnaire is at all necessary and I am inclined to believe that the questionnaire is not in the interest of the taxpayers.

COMMENT BY MR. BEATTY ON MR. BOSWELL'S DISCUSSION

My dear Mr. Boswell:

I wish to thank you for the invitation to comment on your paper on prequalification on public works contracts. You state that you "feel there are advantages in the use of the questionnaire." I feel that there may be weak spots in prequalification procedure. The purpose of my writing on the subject is to discuss these advantages and weaknesses with a view to improving the former and diminishing the latter.

Unlike the little bear which clouted the whole hive into the river because one bee stung his nose, I want to retain the good while getting rid of the bad. I do not think we are justified in assuming that prequalification will do more harm than good until this has been demonstrated by trial. By trial alone can the weak spots be shown up, and if there prove to be more weak spots than strong ones and we cannot eliminate them, I shall cease to advocate prequalification. But I want to be shown.

The chief weakness in prequalification which I see at present is the human element in applying it. Carefully and intelligently applied, it should relieve a situation which is admittedly bad in public works construction contracts. I think that a board consisting of one city official and two outside disinterested engineers or business men, not contractors, should do the prequalifying, and that the action of this board should be subject to review by a court or by a committee appointed by a court. I suggest the board because its decision would carry more weight than an individual's and its judgments should be better. And it should still the howl of political favoritism or bad judgment now likely to be raised by the disqualified. I suggest the committee because the court should have competent advisers in technical matters. Would this meet the objection in the sixth paragraph of the judge's letter?*

Turning to the second paragraph,† on bonds: I believe it to be indisputable that bonding companies have been known to evade their responsibilities on technicalities; that even if they meet their obligation 100 per cent, there are other losses, due to delay and interference with dependent interests, to additional engineering and inspection costs, to inferior workmanship, which are likely to occur before the bonding

* In his discussion, Mr. Boswell quoted a letter from a "prominent judge" who said, in his sixth paragraph: "With the discretion in being sole judge of the questionnaires and of determining who shall bid and who shall not, it is only human nature for a man in the profession of favoring one man or group to the public detriment and sometimes for more than mere personal regard."

† This paragraph of the judge's letter is the same as the first paragraph under "Unnecessary and Unconstitutional" of Mr. Boswell's abstract above.

company steps in. In other words, the surety company does not pretend to recompense the taxpayer for all losses, and the best way to save money for the taxpayer is to avoid all losses. The surest way to avoid the losses seems to be to give the work to a responsible contractor. This in reference to the judge's second paragraph.

Considering the third paragraph,§ can we imagine any way for a municipality to exercise the authority which it receives from the state, except through its delegation to an individual or a group? Theoretically the people of the state, including the people of the town, agree that the people of the town may build water works. Of necessity the people of the town select an individual (or group) whom they think competent to carry on the work. The individual selects another individual whom he believes competent to construct the work. Must there not always be choice and delegation of authority? What difference legally should it make whether the discretion-exercising individual exercises his discretion before or after the bids are in? If all the bidders were responsible, all could qualify. If some were not responsible, the official might have to refuse a proposal which incompetence has made too low, and this leads to conflict and disputes. We know that just this situation does arise, and that the court does recognize the official's discretionary power. Furthermore, to deal with all contractors with approximate equality, the contractors themselves must be approximately equal. What discretion would a man exercise, how would he be acquitting himself of his duty to the taxpayer, if he accepted the bid of a bankrupt fly-by-night on an exact parity with that of a fully equipped and financed business man?

The privacy of the questionnaire must be inviolate, that is, it must not be made public. But it would be a grave error to attempt to confine its contents to one man, as well as practically impossible. The state and national contractor organizations, in advocating prequalification, were willing to trust the discretion of these officials.

The "vicious forms of questionnaire" referred to in paragraph five,†† simply emphasize the need for a general adoption of and familiarity with the impartial Standard Questionnaires and Financial Statement for Bidders first issued in 1925 by the Joint Conference on Construction Practices.

Turning to page 8 of your paper,** I can see no good reason for not permitting any one who wishes to make the required deposit, to take out plans and specifications—with the understanding that bids will be accepted from qualified contractors only.

Let us not attempt to destroy prequalification until we have given it a trial. Let us rather devote our energies to straightening out the crooks which may appear in any new measure.

Yours very truly,

PHILIP A. BEATTY,

Staff Engineer, Philadelphia Bureau of
Municipal Research.

§ This is the paragraph in Mr. Boswell's abstract beginning "Further, it is a delegation," etc.

†† The paragraph beginning "The most vicious forms."

** See the paragraph beginning "Authority for Use of Questionnaire" and the two following ones.

Prequalification of Bidders in Philadelphia

Last year the city council of Philadelphia passed an ordinance "Providing for the prequalification of prospective bidders for contracts for construction work by requiring answers to inquiries or questionnaires in advance of bidding, showing the fitness of such prospective bidders to perform said contracts; authorizing the refusal to receive or schedule bids when such information is refused or not given or when it appears that the said proposed bidder is not sufficiently qualified to perform the said contracts."

Some of the city departments proceeded to act upon this ordinance, but an injunction was brought and the Court of Common Pleas in November declared the ordinance illegal. It was expected that the city would appeal to higher courts.

The section of the ordinance defining the prequalification requirements was as follows:

"Not later than 96 hours prior to the time of opening bids for the construction of public works, the director or other official in charge of letting any contract therefor shall require and receive from any and all known prospective bidders a sworn statement in answer to a questionnaire or inquiry in standard form, showing that such intended or prospective bidder has the necessary facilities, experience and financial resources to perform the work in a proper and satisfactory manner within the time stipulated. Such statements must designate and describe the plant, equipment and facilities of the bidder, relate his experience in doing the same or similar work and disclose his financial resources, specifying the amount of his liquid and other assets and liabilities and the number and amount of his other existing contracts or commitments, including and indicating those with the city; said statements shall be confidential. Should the information so required be refused or omitted to be given, or should it, in the judgment of the awarding officer, reveal that the prospective bidder is not sufficiently equipped or qualified to enter into or perform the stated contract, no bid therefor from such bidder or bidders shall be received or scheduled and the awarding official shall forthwith notify the proposed bidder thereof."

It is further provided that if the bidder is dissatisfied with such rejection, he may appeal to a board composed of the awarding officer and two other heads of departments, chief of bureaus of other departments, or other city officials connected with construction work, to be designated by the mayor. Should any statement made in the answer to the questionnaire be found to be false or deceptive, the certified check of the bidder is to be retained by the city as liquidated damages.

Refuse Collection Not a Public Health Function

The Common Council of the city of North Tonawanda, N. Y., has transferred collection of garbage and refuse from the health department to the department of public works.

Other municipalities might well profit by the example of North Tonawanda. Health departments should be relieved of all work which has no relation to the public health.

RECENT LEGAL DECISIONS

LIABILITY FOR "DAMAGING OR DESTRUCTION" OF PROPERTY ON ACCOUNT OF PUBLIC USE

The Texas Commission of Appeals holds, *Hidalgo County Water Improvement Dist. No. 2 v. Holdenbaum*, 11 S. W. (2d) 506, that "damaging or destruction" on account of public use, required to be compensated by section 17, art. 1 of the state Constitution, includes injury resultant (a) of construction of works, and (b) of subsequent maintenance and operation, and presupposes its infliction by the state or by state authority. A water improvement district, whatever its degree as a public or governmental agency, has no immunity from liability for injuries referred to in the section.

TAXATION OF PAVING COMPANY'S PROPERTY

Sustaining the protest of a paving company against the assessment of certain property of the corporation locally assessed for taxation by a county board of equalization, such property consisting of a steam shovel, tractors, warehouse, motors and other equipment, the Oklahoma Supreme Court holds, *Standard Paving Co. v. County Board of Equalization of Beckham County*, 273 Pac. 201, that, under Comp. Stat. 1921, section 9265, tangible property of a corporation, having a fixity of situs, and used in connection with doing the corporation's business in another county than that of its principal place of business, is subject to local taxation in the county in which such property is situated. "Doing business in another county," within the meaning of the section, implies a continuity of conduct in that respect, such as might be evidenced by the investment of capital and the maintenance of an office or place for the transaction of business, together with incidental circumstances showing an intent to carry on a business there, resulting in a portion of the property being incorporated in the bulk of the property of the county and used for some substantial period of time in such a manner as other property of like character of the local taxing district is used.

VALIDITY OF WATER, LIGHT AND SEWER BONDS

The Arizona Supreme Court holds, *Walmsley v. Laird*, 273 Pac. 536, that bonds issued for paving street intersections, whatever may be their classification, do not fall within water, light and sewer class, and therefore, under art. 9, § 8 of the state Constitution, are not to be considered in deciding whether the 15 per cent. indebtedness allowed for the last named purposes has been exceeded.

FUNDS FROM SALE OF PARK PROPERTY AVAILABLE FOR PARK PURPOSES

The North Carolina Supreme Court holds, *Hall v. Redd*, 196 N. C. 622, 146 S. E. 583, that the limitation on the power of the Charlotte park and recreation commission contained in the private act creating the commission not to contract any debt or incur any obligation in excess of the taxes levied for park purposes for the current year does not prohibit the commissioners of the city from appropriating funds al-

ready in hand, derived from the sale of park property, for park purposes, or for a legitimate public use.

OBSTRUCTIONS OR EXCAVATIONS AT SIDES OF STREETS

The West Virginia Supreme Court of Appeals, *Silverthorn v. City of Chester*, 146 S. E. 614, holds that the duty of a city or town to keep its streets and sidewalks safe for foot passengers and vehicles is not met by keeping simply the bed of the highway or the surface of the sidewalk in proper condition; such duty is violated if a dangerous obstruction or excavation is permitted so close to the margin of the sidewalk or highway as to make the use of it dangerous.

APPORTIONMENT OF COST OF BRIDGE CROSSING RAILROAD

The Minnesota Supreme Court holds, in re Commissioner of Highways, 223 N. W. 915, that where a trunk highway and a railroad track intersect, the railroad and warehouse commission may require the construction of an overhead or underground crossing and divide the cost between the railroad company and the highway department; and may do so whether the highway is about to be opened across the tracks or is already opened across them at grade. Where a highway is carried over railroad tracks by a bridge, the railroad company may be required to construct the bridge and approaches, but not a part of the highway not included within the bridge or approaches.

IMPROVEMENT ASSESSMENT MADE WITHOUT REGARD FOR BENEFITS

The Minnesota Supreme Court holds, in re Meyer, 223 N. W. 135, that the presumption of validity attending an assessment by the proper authority of the cost of a public improvement, while strong, is rebuttable. When that presumption is opposed by positive evidence that the assessment was made arbitrarily and without regard to actual benefits and that in fact it was in excess of such benefits and so confiscatory, an issue of fact arises upon which ordinarily the decision of the trial court is final.

EFFECT OF BOND ON SUMS DUE CONTRACTOR

Where a contractor's bond is given as provided by the Mississippi statute, Code 1927, § 2598, funds due the contractor are released from equity or trust in favor of materialmen and laborers, under § 2596, and go into the hands of the contractor untrammelled.

TIME AS ESSENCE OF CONTRACT FOR MATERIAL

A public works contractor, in reliance on a telegram from a materialman, presented a bid for the construction of a school. It was afterwards discovered that the telegraph company had made a mistake in transmitting the telegram. The parties thereupon agreed on a certain price on condition that the materialman furnish the material within a certain period. The Louisiana Supreme Court holds, *Winkle Terra Cotta Co. v. Butler*, 166 La. 241, 117 So. 134, that time thereupon became of the essence of the agreement to pay the additional amount specified in such agreement,

and, on the failure of the materialman to furnish the material within such time, recovery could not be had for the additional amount therein specified. *

ACCEPTANCE OF OFFER MUST BE UNQUALIFIED TO COMPLETE THE CONTRACT

A written acceptance of a written offer is not necessary to complete a contract if the offer is in fact accepted and acted upon by the parties, but to be effectual the acceptance must be positive and unambiguous, identical with the offer and unconditional. A contractor made a written proposal to do excavation work for a lump sum price of 47½ cents per yard. In an action for balance due, the plaintiff's evidence was to the effect that in discussion of this offer it was verbally agreed that it was for earth and shale only and if solid rock was encountered a reasonable price would be paid for such rock excavation, and with this understanding and agreement the contractor was instructed to proceed with the work. Defendant's evidence was to the contrary, and that the written offer was delivered and unconditionally accepted and acted upon. The Alabama Supreme Court held, *Stephenson Brick Co. v. Bessemer Engineering & Construction Co.*, 218 Ala. 325, 118 So. 570, that if the plaintiff's version was accepted the original proposal did not constitute a completed contract between the parties, since there was no acceptance identical with the offer, but if the defendant's version was accepted, the evidence showing a full payment of the amount which would be due if the written offer was to control, the verdict should be for the defendant. The evidence conflicting, the question was for the jury. Judgment granting plaintiff's motion for a new trial on recovery of judgment for one cent was affirmed.

CLAIM FOR EXTRAS UNDER PAVING CONTRACT

An item of a paving contract was: "6,468 cubic yards local stone from pit shown east of town for base, \$1.54 per cubic yard." The contract was on a proposal and acceptance, with a specified price for each unit. The quantities were stated to be approximate only and to serve as a basis for the comparison of bids. The amount actually laid might be increased or decreased by the engineer, and if the contractor proceeded with over 25 per cent increase or decrease without readjustment of compensation, he could not claim any increased price per unit for the variation. He proceeded without adjustment, and claimed that an increase of more than 25 per cent was made. The city claimed a decrease of about 25 per cent. In an action for the balance of the contract, where this was the only item in dispute, the city offered to arbitrate the matter under the clause of the contract entitled "Alterations," providing for arbitration in case of disagreement as to any adjustment or decision by the engineer. The Texas Court of Civil Appeals held, *Dozier v. City of Gatesville*, 4 S. W. (2d) 131, that the contractor was entitled to recover for extra stone delivered at the price stipulated in the contract without submission to arbitration, as contended by the city, since the extra delivery was not an "alteration," within the arbitration provision. No testimony was introduced on the trial except as to the execution of the contract, the trial court sustaining the city's plea in abatement. The appellate court, for the reason given, reversed this judgment and remanded the cause.

PERSONAL LIABILITY FOR ROAD WORK OF COMMITTEE FOR GENERAL PUBLIC

A road contractor sued five persons, alleging that he contracted with them to remove 174 yards of dirt and stone from a hill on a newly constructed road for an agreed price; that he performed the contract and they refused to pay. The defense was that defendants were a committee representing the general public in the construction of the road, and that, as the plaintiff knew, the money to pay for his services was to be donated by the public. The Texas Court of Civil Appeals, *Redden v. Capps*, 15 S. W. (2d) 670, held that the chairman of the committee who actually made the contract was personally liable, and the other defendants would also be personally liable thereon if they authorized the chairman to make it, or subsequently assented thereto, or ratified it. There was here no legal body to be bound by the action of the committee.

WAIVER BY MATERIALMAN OF HIS RIGHTS UNDER STATUTORY ROAD CONTRACTOR'S BOND

A materialman furnishing materials for the construction of a street improvement has no lien therefor under the Arkansas statute, C. & M. Digest, §6906. It is because there can be no lien where materials enter into the construction of a public improvement that section 6913 was enacted, requiring a public works contractor's surety bond to protect materialmen and laborers. In this case the materialman furnishing the cement wrote the surety company that if the statutory bond were made he would waive his rights thereunder. In these circumstances, it was held, *Johnson v. Flynn*, 15 S. W. (2d) 327, that the materialman having waived his rights under the bond, he had no rights in the fund due the contractor than any other creditor. He was the only creditor for material entering into construction of the work.

INJUNCTION NOT A REMEDY TO RESTRAIN LAYING OUT OF ROAD FOR LACK OF NECESSITY AND DAMAGE TO LAND

The Texas Court of Civil Appeals, *Withington v. Hunt*, 15 S. W. (2d) 178, dissolved a temporary injunction restraining the laying out of a public road by a commissioner's court, where the facts showed a strict compliance with the statute as to laying out roads, where the injunction was sought solely on the ground of a lack of necessity for the road and damages it would cause, since courts of law are open to the citizen to recover any damages inflicted on his land.

UNDER OHIO STATUTE MUNICIPALITY MAY MAKE EXCLUSIVE CONTRACT FOR REMOVAL OF GARBAGE

The Ohio Appellate Court, *City of Cincinnati v. State ex rel. Mook*, 30 Ohio App. 449, 166 N. E. 235, holds that under section 4326, Ohio General Code, placing the management of garbage under the direction of the director of public service, and a municipal ordinance requiring a permit for the transportation of garbage through the city streets, the city has power to control the disposal of its garbage in the way it does; and the city manager did not abuse his discretion in refusing the permit and granting the exclusive collection to an individual corporation by contract, and there was no violation of any constitutional rights of the applicant for the permit, who had an arrangement with certain hotels for the removal of their garbage.

Engineering Societies

Feb. 17-19—Cement Gun Contractors' Association. Annual Convention at the Palmer House, Chicago, Ill.

Feb. 18-19—PENNSYLVANIA ASSOCIATION OF PLANNING COMMISSIONERS. Fifth Annual Conference at Easton, Pa. L. J. Buettner, Secy.-Treas., City Hall, Johnstown, Pa.

Feb. 19-21—ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES. Annual Convention at Syracuse, N. Y. A. Lee Grover, Secy., State Highway Comm., Trenton, N. J.

Feb. 19-21—NEW JERSEY MOSQUITO EXTERMINATION ASSOCIATION. Annual meeting at Atlantic City, N. J. Thomas J. Headlee, Secy., New Jersey Experiment Station, New Brunswick, N. J.

Feb. 25-28—Fifth Annual SOUTHWEST ROAD SHOW AND SCHOOL. Wichita, Kans. F. G. Wieland, Mgr., Exposition Bldg., Wichita, Kans.

March 21-22—NEW JERSEY SEWAGE WORKS ASSN. Annual meeting at Trenton, N. J. John R. Downes, Secy., Bound Brook, N. J.

April 14-19—NATIONAL FLOOD CONTROL CONGRESS. Memphis, Tenn. R. E. Logsdon, Chamber of Commerce, Chisca Hotel, Memphis, Tenn.

June 2-6—AMERICAN WATER WORKS ASSN. Annual convention at St. Louis, Mo. Beekman C. Little, Secy., 29 West 39th St., New York.

The Road Show and American Road Builders' Association

The twenty-seventh annual Road Show and convention, held at Atlantic City, January 11-18, was well attended, as usual, and a success from every angle except the weather. Despite official promises from the city government, rain operated on double shifts, and even snow appeared.

The machinery of the show operated smoothly; the new system of committee reports, eliminating, to a large extent, individual papers, worked better than expected, and the material presented was on the whole, excellent and of greater value than that of any previous Road Show. Mr. Upham and Mr. Conner are to be congratulated on doing away with the long and tiresome sessions so frequently staged by speakers without terminal facilities.

Abstracts and summaries of most of the papers and reports presented appear on other pages of this issue.

W. A. Van Duzer of Harrisburg, assistant chief engineer of the Pennsylvania department of highways was select-

ed as president of the association for the ensuing year. Mr. Van Duzer and the other officers elected for the new year will be installed at the Washington conference in May. Other officers are:

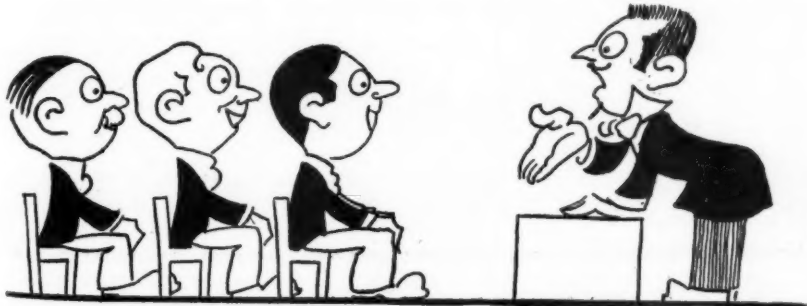
Vice-presidents J. R. Draney, Natural Rock Asphalt Corporation, Louisville, Ky.; Henry G. Shirley, Richmond, Virginia State Highway Commissioner; S. F. Beatty, president of the Austin-Western Road Machinery Company, Chicago, Ill.; Samuel Hill, honorary life president, Washington State Good Roads Association, Seattle.

James H. MacDonald, New Haven, Conn., a founder and past president of the Association, was reelected treasurer.

Directors for three-year terms are as follows: C. M. Babcock, Minnesota State Commissioner of Highways, St. Paul; T. H. Cutler, Jefferson City, chief engineer, Missouri State Highway Commission; H. J. Kaiser, Oakland, Cal.; W. M. Kinney, general manager, Portland Cement Ass'n., Chicago; William P. McDonald, Flushing, N. Y.; George F. Schlesinger, general manager, National Paving Brick Manufacturers' Association, Washington, D. C.; U. S. Senator John G. Townsend of Delaware.

Col. C. E. Myers, Philadelphia director of transit, is president of the City Officials' Division. Other officers are: Vice-presidents: L. W. Herzog, Commissioner of Public Works, Albany, N. Y.; Bryson Vallas, city engineer, New Orleans, La.; M. M. O'Shaughnessy, city engineer, San Francisco; directors for three-year terms: Robert B. Brooks, director of streets and sewers, St. Louis, Mo.; M. B. Herlong, chairman of Park Board, Jacksonville, Fla.; D. L. Lewis, city engineer, Fort Worth, Texas; Charles M. Reppert, chief engineer, Department of Public Works, Pittsburgh; Ralph L. Rizer, city engineer, Cumberland, Md.; Robert H. Simpson, chief engineer, Department of Public Service, Columbus, Ohio; John C. Shaw, city engineer, Los Angeles, Cal.

In the County Officials' Division: Stanley Abel, supervisor, Kern County, California, was elected president; vice-presidents are: L. O. Marden, county engineer, Worcester County, Worcester, Mass.; W. O. Washington, county engineer, Cameron County, Brownsville, Texas; Otto Hess, county commissioner, Kent County, Grand Rapids, Mich.;



From the Road Builders' News
The Technical Sessions at the A. R. B. A. Were Well Attended

AYER & LORD TIE CO.

INCORPORATED

Railway Exchange CHICAGO

Railroad Cross

Ties—Timber

Products—

Lumber—Poles

Piling—Fence

Posts

Wood Treatments
and Preservation

PLANTS

Carbondale, Ill., Grenada, Miss.,
Louisville, Ky., North Little Rock, Ark.,
Montgomery, Ala.,
Marine Ways-Paducah, Ky.

"CREOSOTE OIL
PREVENTS DECAY"

For Late Information on
Sewage Treatment and Refuse
Disposal, see pages 80-81 in the
rear.

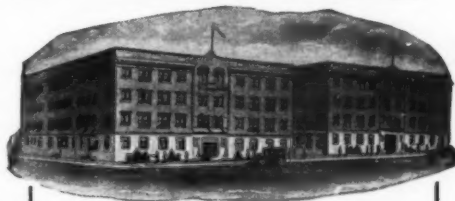


The Crossroads
of the
Country
are marked by
The "EARLY"
Signs

Write for descriptive
folder and prices

TRAFFIC & STREET
SIGN CO.

86 Foundry St., Newark, N. J.



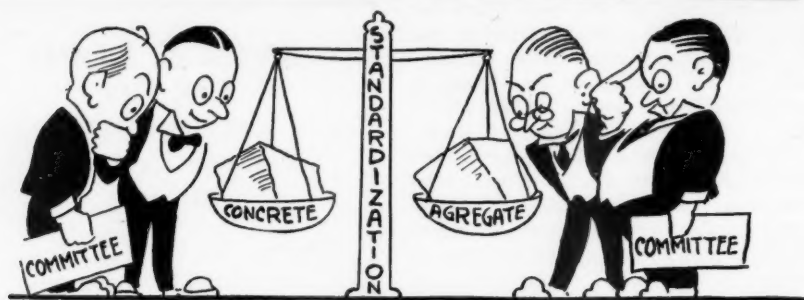
200 APTS., 300 ROOMS

Milwaukee's finest popular-priced apartment hotel—near Lake—four blocks from business section. Each apartment has bath and shower. Beauty salon. Dining Room. Excellent garage and parking facilities.

Attractive weekly and monthly rates

THE PLAZA

551 Cass at E. State
On U. S. Highway 141
MILWAUKEE



From the Road Builders' News

George W. Jones, county superintendent of highways, Los Angeles, Cal. Directors for three-year terms: H. M. Clark, county roads engineer, Salisbury, Md.; B. W. Davis, county engineer, Nashville, Tenn.; Arthur Hargreaves, county highway superintendent, Armour, S. D.; R. C. Hill, county engineer, Georgetown, Del.; T. L. Pendegrass, county superintendent of roads, Durham, N. C.; Hal G. Sours, county engineer, Akron, Ohio; Charles D. Vail, chairman, Board of County Commissioners, Denver, Col.

M. A. Corroalles, of Cuba, engineer in charge of the \$76,000,000 Central Highway project in Cuba, was elected to succeed Senor Octavio Dubois, president of the Mexican Highway Commission, as president of the Pan American Division. Senor Dubois was elected president of the division when it was organized two years ago and has served two full terms.

Flood Control Congress

The first National Flood Control and Navigation Congress will be held at the Mid-South Fair Grounds, Memphis, Tenn., April 14-19 under the auspices of the Memphis Chamber of Commerce.

No subject has been more discussed since the disastrous flood in the lower Mississippi Valley than that of flood control. Acceptance by Congress of flood control for the Mississippi Valley as a national responsibility was followed by passage of the Flood Control Act and the adoption of what is known as the Jadwin plan, so-called because of the part played in this plan by the former chief of the U. S. Engineers. Work under this plan is now going on. Modifications and delays have followed protests in regard to certain features of the plan. Other protests are still being voiced. The question of whether levee control of the Mississippi River or a great reservoir system will better solve the problem is being discussed, with advocates of both methods voicing their opinions at public gatherings, executive sessions of interested groups, or in the press of the country.

Without in any way taking sides on any of the points in controversy, the Board of Directors of the Memphis Chamber of Commerce is convinced that the time has come to bring together, from all parts of the United States,

those persons who are most interested in the subject of flood control for navigable streams. At this Flood Control and Navigation Congress the facts in regard to the problems of all valleys of navigable streams affected by floods will be presented by the men most fully equipped with knowledge of those facts. The information so presented will then be assembled into a complete picture which will, for the first time, indicate not the flood problem of one valley, or the problems of several valleys in the same section, but the problems of all valleys of navigable streams where the question of flood control arises.

This complete picture of the flood control needs of valleys throughout America will be made part of a report addressed to the National Government, with accompanying recommendations that a national policy of flood control covering all valleys of navigable streams, shall be speedily adopted and immediately thereafter put into effect.

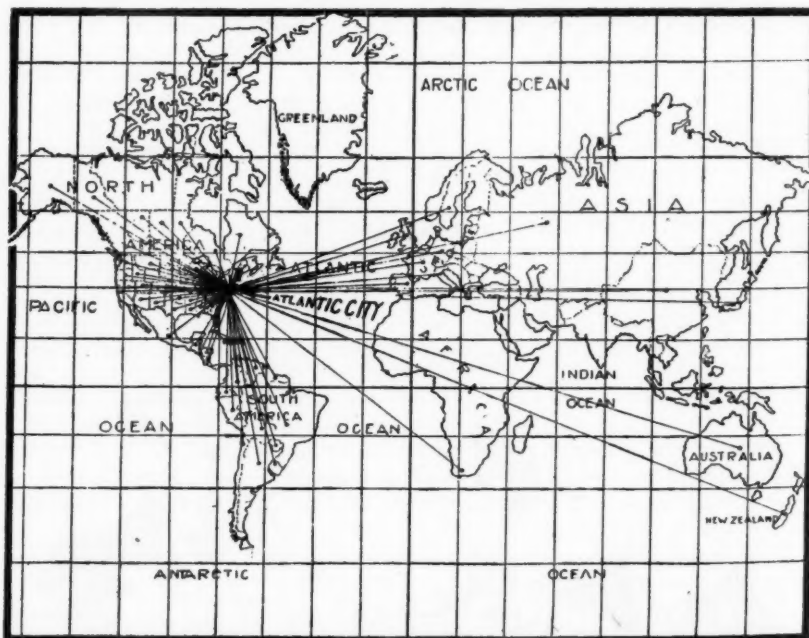
The questions of how adequate flood control is to be secured and financed; and the means of providing flood control to all valleys where it is needed, will not be determined by the Flood Control Congress. These are functions of the National Government and will be left to the Congress of the United

States and the national authorities to decide. The big need, however—adoption of a national policy—which will cover the whole flood control situation in all valleys subject to floods, will be urged in recommendations which will carry with them the backing of a larger constituency, over a wider area, including more states than have ever before participated in a request for flood control.

An attendance of between 15,000 and 20,000 is looked for by R. E. Logsdon, director of the Chamber of Commerce Convention Bureau, who is handling the arrangements for the Congress and the accompanying Exposition. Invitations to attend have been sent to members of both houses of Congress, to governors, mayors, heads of national, state and municipal departments, farmers, bankers, heads of industrial plants and business firms, engineers, contractors, manufacturers of flood control machinery and equipment, and residents of the valleys of all streams affected by flood waters.

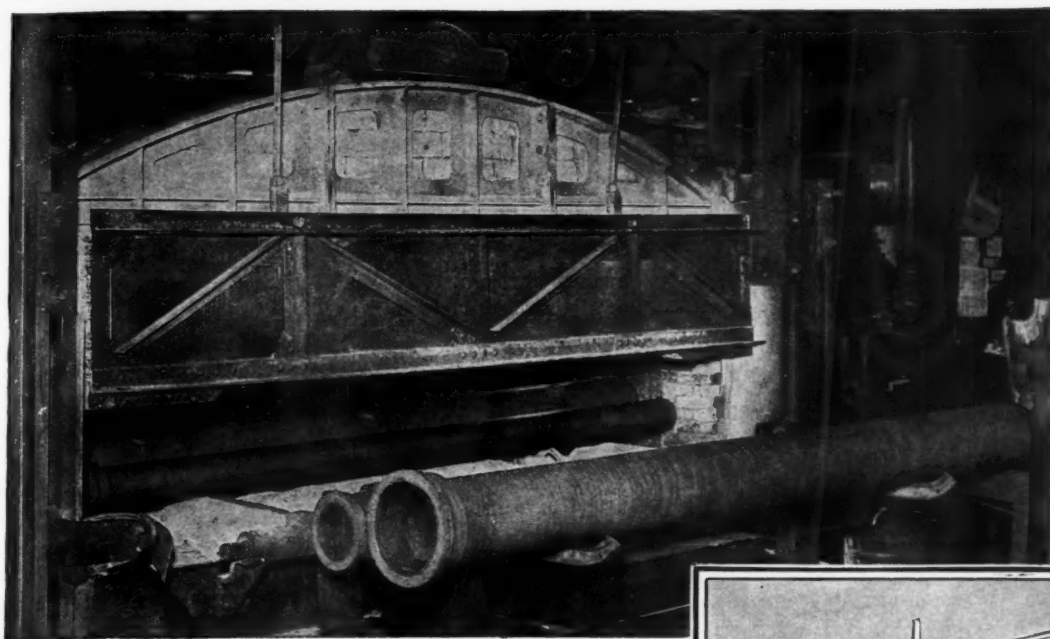
In connection with the Flood Control and Navigation Congress there will be held the largest and most comprehensive exposition ever assembled of all types of machinery and equipment used in flood control and navigation projects.

Four of the largest buildings at the Fair Grounds will be required, one for sessions of the Congress, the other three for indoor exhibits. A fifth building will be used for headquarters offices, and for use of committees. A large amount of acreage at the Fair Grounds will also be devoted to outdoor exhibits. The indoor and outdoor displays and demonstrations of methods of work will require in excess of one million square feet. There will also be extensive exhibits on the Mississippi River in front of Memphis.



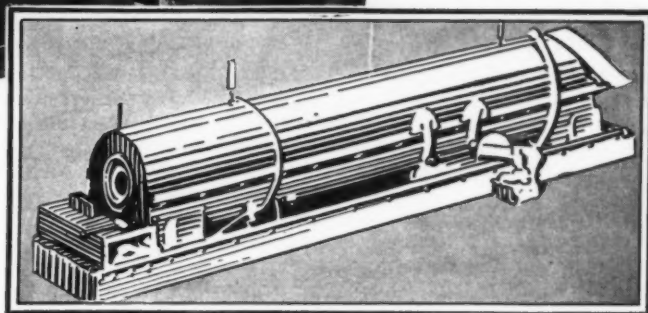
From the Road Builders' News

Where Road Show Delegates Came From



The large photograph shows the deLavaud annealing furnace where controlled temperatures uniformly anneal every length of deLavaud pipe.

Below is the famous deLavaud machine which produces the strongest cast iron pipe known.



Controlled annealing gives deLavaud pipe uniform strength and flexibility

THE controlled annealing in the manufacture of deLavaud pipe may be regarded as one of the greatest advances in the cast iron pipe industry. All cast iron pipe must be annealed at some stage of its manufacture. For annealing, as every engineer knows, reduces brittleness and tends to eliminate casting strains.

But only in the manufacture of deLavaud pipe is the annealing process accurately controlled. Every length of deLavaud pipe is heated in an oven to a temperature of 1750 degrees and *uniformly* annealed from bell to spigot. The result is the uniform flexibility of deLavaud pipe and absence of all casting strains.

The superior strength of deLavaud pipe is another reason for its wide acceptance. deLavaud pipe is made by pouring molten

iron into a rapidly revolving metal mold. This mold is water jacketed. When the molten iron comes in contact with the chilled surface of the mold, a physical change takes place in the structure of the iron; all the coarse particles become finely and evenly divided. At the same time centrifugal force—a force 40 times greater than gravity—drives out impurities at the center.

The fine grain structure of deLavaud pipe metal together with its remarkable freedom from impurities enable deLavaud pipe to show an average tensile strength of more than 30,000 lbs. per square inch.

Let us send you a copy of the deLavaud handbook. It contains facts and figures regarding the most interesting pipe development in recent years.

United States Pipe and Foundry Co., Burlington, N.J.

Sales Offices:
New York

Philadelphia
Pittsburgh

Cleveland
Buffalo
Chicago

Our pipe bears the "Q-Check"
trademark of The Cast Iron
Pipe Research Association

Dallas
Birmingham
Kansas City

Minneapolis
Seattle

San Francisco
Los Angeles

Please mention PUBLIC WORKS when writing to advertisers.

Diesel Engine Manufacturers' Assn.

The Diesel Engine Manufacturers' Association announces the election of the following officers for the year 1930: President, A. E. Ballin of McIntosh & Seymour Corporation, Auburn, N. Y.; Vice President, George Codrington of Winton Engine Co., Cleveland, Ohio; Chairman, Executive Committee, E. T. Fishwick of Worthington Pump & Machinery Corp., 2 Park Avenue, New York; Chairman, Technical Committee, H. W. Dow of Nordberg Mfg. Co., Milwaukee, Wisconsin; Secretary and Treasurer, H. A. Pratt of Ingersoll-Rand Co., 11 Broadway, New York.

Personals

Henry F. Alexander has been appointed Director of Public Service of Lorain, Ohio.

W. R. Hopkins, city manager of Cleveland since the city adopted that plan of government in 1924, was removed from office on Jan. 12 by the new city council.

Howard A. Johnson, formerly of the Oxford, N. C., waterworks, is now in charge of water purification at Danville, Va.

Leonard C. L. Smith of Queens, N. Y., has been appointed engineer member of the Sanitation Commission of New York City for a term of four years.

H. D. Palmore has been appointed State highway engineer of Kentucky, succeeding J. S. Watkins. Other resignations in the department, which has been a storm center for some time, include W. M. Jarvis, engineer of maintenance, and D. Niles Evans, engineer of equipment.

Lloyd R. Wilson, formerly with the Lakewood Engineering Company, Cleveland, is now associated with the C. O. Bartlett & Snow Company, Cleveland, as manager of sales of Bartlett-Snow truck bodies for transporting ready mixed concrete.

John Van Nostrand Dorr, chemical and metallurgical engineer and president of The Dorr Company—Engineers has been awarded the James Douglas Medal of the American Institute of Mining and Metallurgical Engineers in recognition, according to the citation, "of his invention of apparatus and achievement in developing and improving hydrometallurgical practice." This medal, awarded annually for distinguished service in non-ferrous metallurgy, commemorates Dr. James Douglas, twice president of the A. I. M. E. and founder of the Phelps Dodge enterprise, and will be presented formally at the annual convention of the Institute in New York in February 1930.

J. D. Capron, for many years publicity manager of the United States

Pipe and Foundry Co., Burlington, N. J., has resigned to become general manager of the Glamorgan Pipe and Foundry Co., Lynchburg, Va. Mr. Capron is succeeded as publicity manager by S. E. Linderman.

Civil Service

The United States Civil Service Commission announces the following open competitive examination:

Engineering Aide.—Applications must be on file at Washington, D. C., not later than March 4. The examination is to fill vacancies in the Interstate Commerce Commission and in positions requiring similar qualifications, for duty in Washington, D. C., or in the field. The entrance salary is \$1,800 a year. The duties are to make calculations of land areas or the computation of grading, track, and other items of property from field notes, and the collection of these for pricing, and related work as required. Competitors will be rated on general physics, mathematics through analytic geometry, and on practical questions on elementary engineering.

Engineer.—Applications for associate, \$3,200 to \$3,700 a year, and assistant, \$2,600 to \$3,100 a year, engineers must be on file at Washington, D. C., not later than March 12. The examinations are to fill vacancies occurring throughout the United States. Eligibles are especially desired for the Supervising Architect's Office, Treasury Department. Also, there is a vacancy at Edgewood Arsenal, Maryland, in a position of assistant mechanical engineer qualified as specification writer. The optional branches are (1) aeronautical, (2) agricultural, (3) architectural (estimator and computer), (4) architectural (specification writer), (5) chemical, (6) civil (general), (7) electrical, (8) heating and ventilating, (9) highway, (10) mechanical, (11) radio, (12) structural steel and concrete bridges, (13) structural steel and concrete buildings, (14) any other specialized branch of engineering work. The duties will be in connection with original research or investigation, or design and construction, in one of the various branches of engineering listed above. Competitors will not be required to report for examination at any place, but will be rated on their education, training, and experience.

Hydraulic Engineer.—Applications for hydraulic engineer, (\$3,800 to \$4,400) associate hydraulic engineer, (\$3,200 to \$3,700), assistant hydraulic engineer, (\$2,600 to \$3,100), must be on file at Washington, D. C., not later than March 12. The examinations are to fill vacancies in the Engineer Department at Large, War Department, throughout the United States, and in

positions requiring similar qualifications. The duties of hydraulic engineers will be to undertake, under the general supervision of superiors, studies for the improvement and utilization of rivers for navigation, flood control, power development, or irrigation, or any combination thereof. The work may include some or all of the following items: Planning and execution of topographic and hydrographic surveys; stream gauging and the collection and analysis of hydrologic data; selection of dam and reservoir sites and canal locations by reconnaissance or from maps; preparation of plans and cost estimates for dams, locks, power houses, canals, levees and other hydraulic structures.

Competitors will not be required to report for examination at any place, but will be rated on their education, experience, and fitness.

Information.—Full information on all the above positions may be obtained from the United States Civil Service Commission, Washington, D. C., or the Secretary of the United States Civil Service Board of Examiners at the post office or customhouse in any city.

Trade Publications

Solution vs. Direct Feed Chlorination.—Reprint of paper by Marshall Wellington, in charge of chlorination, New Haven, Conn. Published by Wallace & Tiernan Co., Inc., Newark, N. J.

Centrifugal Pump Selection Charts.—Goulds Pumps, Inc., Seneca Falls, N. Y., has published a valuable set of charts to aid in selecting pumps. The charts show a wide range of capacities and heads. Ask for bulletin 1200, using the coupon on page 77.

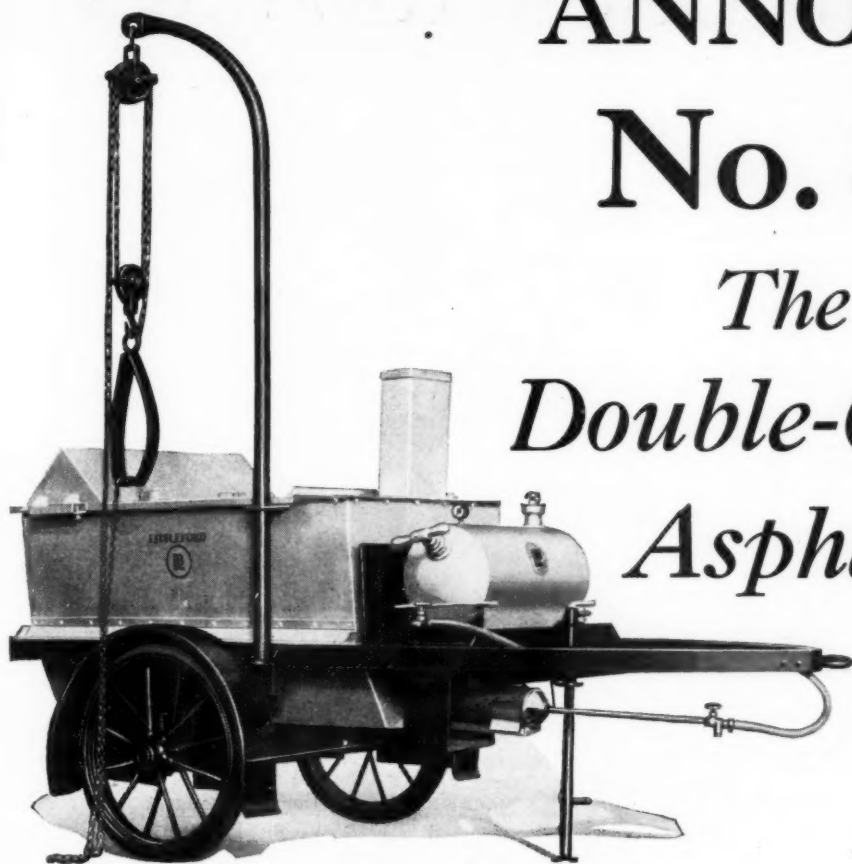
Vertical Centrifugal Pumps.—Layne & Bowler, Inc., Memphis, Tenn., have just published a new pump bulletin, which illustrates and describes the operation of a new deep well centrifugal pump. This is of value to anyone interested in deep well pumping.

Sewage Treatment Plants.—An illustrated book devoted to sewage treatment plant equipment has just been issued by Link-Belt Company of Chicago and Philadelphia. This book, No. 642, devotes its 24 pages to the Straightline Screen, the Brunotte Sewage Screen, the Tark Sewage Screen for the clarification of municipal and industrial sewage, the Link-Belt Mechanical Aerator for activated sludge plants, and Straightline Collectors for settling tanks, grit chambers and grit washers. Engineering data are incorporated; diagrammatic drawings of equipment and photographs of installations make this book worthy of being in every engineer's library. A copy will be sent upon request.

ANNOUNCING

No. 84-HD

The Newest
Double-Circulation
Asphalt Kettle



The New 84-HD Maintenance Kettle has semi-elliptical springs, Timken roller bearings and low slung curved chassis that will withstand hardest turning, twisting and backing. Steel tired wheels are standard equipment. Rubber tired wheels and heat guards at slight additional cost. (No. 84-HD is shown fully equipped with barrel hoist and hand spray. There is an additional cost for both.)

DDOUBLE CIRCULATION of heat is a new method of heating never before used in a kettle of from 110 to 210 gallon capacity. This construction involves both redesigned combustion box and melting kettle.

The LB Oil Burner forces an intensely hot flame to rear of furnace—baffles prevent heat from rising until it reaches far end of kettle—then it is drawn by draft up and to front of kettle and out

vent stack—that is *double circulation*. You have controlled heat properly distributed over a wide heating area—rapid melting of material with no coking or flashing.

The new screen construction in the melting tank keeps hot and cold material separate; there is complete circulation of heat around entire tank. You will not find another kettle like it—not *one* that is capable of the same production, not *one* that can be trailed or banged around as much. Ask for complete information about this kettle. We'll gladly tell you about it and you will be under no obligation.

N. B.—This is the first of a series of advertisements formally announcing Littleford DOUBLE-CIRCULATION Asphalt Kettles. There will be another one next month.



LITTLEFORD

Road Maintenance Equipment
SINCE 1900

LITTLEFORD BROS. 452 E. PEARL ST. CINCINNATI, O.

Please mention PUBLIC WORKS when writing to advertisers.

BOOKS AND BOOK REVIEWS

Water Supply Engineering.—By Harold E. Babbitt and James J. Doland. McGraw-Hill Book Co., N. Y. 776 pages, 333 illustrations. \$6.

This book covers very well the entire field of water supply engineering. Among the chapter headings are: Finances, Hydraulics, Rainfall and Run-off, Consumption of Water, Ground Water, Location and Construction of Wells, Dams and Impounding Reservoirs, Intakes and Aqueducts, Steam Power, Steam Pumping Machinery, The Utilization of Electricity, Miscellaneous Engines and Pumps, Centrifugal Pumps, Well Pumps, Pumping Stations and Equipment, Materials, Pipes and Fittings, Design of Distribution Systems, Distributing Reservoirs, Construction and Maintenance of Distribution Systems, Sanitation, Quality of Water, Purification of Water, Sedimentation, Slow Sand Filters, Rapid Sand Filters, Miscellaneous Methods of Water Purification, and Appendices.

It will thus be seen that the range of matter covered is very wide; in fact, it is hard to see how the average instructor can find time to take his class through it with any thoroughness, and it appears difficult to skip material without interrupting the thread of the subject. The book is very well written, the illustrations are pertinent and clear; and recent progress and developments are brought up to date. *Water Supply Engineering* is worthy of a place on the shelf of any engineer who makes a practice of keeping up with the publication of worth-while engineering texts.

The Most Nearly Perfect Food.—By Samuel J. Crumbine and James A. Tobey. The Williams and Wilkins Co., Baltimore. \$2.50.

Under the above title Drs. Crumbine and Tobey have produced a new book on milk. Dr. Crumbine was formerly state health officer of Kansas and is now connected with the American Child Health Association. Dr. Tobey, at present director of health service for the Borden Company, New York City, was formerly secretary of the National Health Council, is the author of a book on public health law and other publications on subjects relating to health, and is a contributor to *Public Works*.

The book was written, as the authors state in their preface, because "There was no modern text devoted entirely to a popular presentation of all of the interesting phases of this one nearly perfect food" and the reader is introduced to the subject in a chapter entitled "One Way to Defer Old Age." There is much historical material and matter descriptive of methods, ancient and modern, of producing, transporting, distributing and using milk which should prove interesting to milk producers and distributors and to officials

concerned with milk sanitation. The book is well illustrated.

Public Finance.—By Harley Leist Lutz. Second edition. 751 pp. D. Appleton & Co., N. Y. \$4.

The second edition has been completely reset, material has been rearranged and some chapters rewritten. New chapters have been added on the poll tax and on the characteristics of American taxation. In addition to a study of the subject of public finance, a comprehensive survey is given of the financial results of publicly owned utilities.

Seven Place Natural Trigonometrical Functions.—By Howard C. Ives. 222 pages. Ill. John Wiley & Sons, Inc. \$2.50.

In addition to the natural functions, this handy little booklet contains miscellaneous tables, and appendices including transit and level adjustments, area computation, vertical curves, simple curves, and determination of latitude, longitude and azimuth.

Formulas and Tables for Engineers.—By C. A. Pierce, Walter B. Carver and Charles E. O'Rourke. Third Edition, 1929, McGraw-Hill Book Co., Inc., New York City. 228 pp., Ill., \$2.

The third edition provides an added amount of civil engineering data which should be of value. A new section contains formulas and allowable stresses for use in design of reinforced concrete elements. The section on mechanics has been rewritten and divided. The section Strength of Materials has been enlarged, and the one on Standard Gauges, Fastenings and Flanges, has been revised. The purely mathematical sections remain unchanged. Many charts and line cuts are given. Students of engineering will find this volume a ready reference book.

Public Budgeting.—By A. E. Buck. First Edition. Harper & Bros., New York and London. 612 pp. Illustrated with charts and diagrams. \$6.

After outlining the development of the budget and discussing the legal basis for budgets practice, Mr. Buck divides his subject into three parts, which are thoroughly covered. The first of these is devoted to budgetary forms and information, including classifications, bills and documents, covering nearly 200 pages. Following is a hundred pages covering fully the procedure in budget making. Finally the execution of the budget is discussed. The book contains indices giving the expenditure classification of the National Government and of the cities of Rochester, N. Y., and Cincinnati, O., and the income classification of the latter city. There is also a selected bibliography.

Our Cities Today and Tomorrow.—By T. K. and H. V. Hubbard, Harvard

University Press, Cambridge, Mass. 389 pp., ill. \$5.

Under a grant from the Milton Fund of Harvard University, the authors conducted during 1928-29 a field study of planning progress in this country, covering about 120 cities and regions in 42 states. The results are summarized in this book, which offers a bird's-eye view of municipal progress and pictures the background of a new social movement.

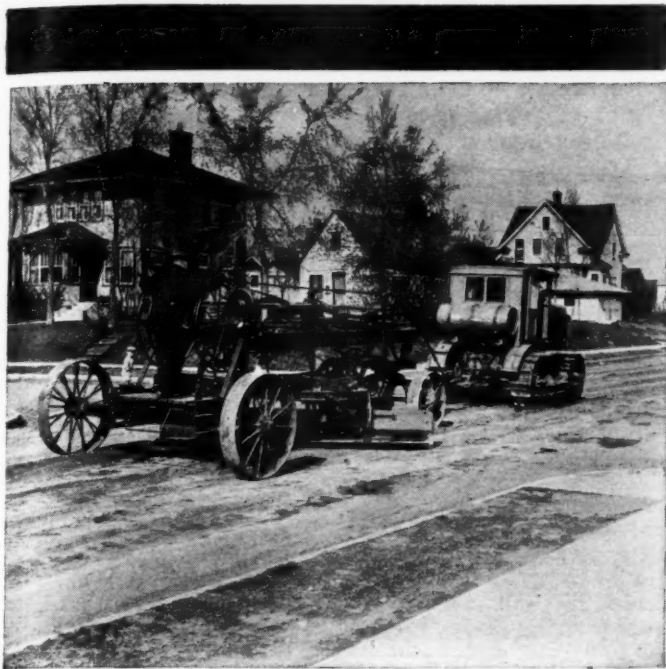
Precise Leveling in Texas (Revised Edition).—The publication bearing the above title, issued by the Coast and Geodetic Survey, contains the standard elevations and descriptions of all permanent bench marks in the State of Texas that were determined by precise leveling. There are also included the elevations of supplementary points, such as marks on masonry, spikes in poles, and the elevation of the top of rail in front of the railroad stations. In printing this revised edition, advantage was taken of the opportunity to bring as many as possible of the descriptions of the bench marks up to date and to correct the elevations of such marks as are known to have been moved. The Texas portion of the precise level net of the United States comprises 18 level lines, totaling 3,970 miles in length and fixing the elevations of 1,802 permanent bench marks.

This publication may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., for 25 cents per copy.

Airway Maps.—The United States Coast and Geodetic Survey is establishing a mailing list in order that those who wish may be notified promptly when new (or new editions of) airway maps are available for sale. No charge is made for this service. At the present time, the Bureau is publishing airway strip maps to the scale of 1:500,000, or about 9 miles to the inch, covering an area 80 miles wide along established airways.

These strip maps show streams, roads, railroads, towns, and elevations, and emphasize features of importance to air navigation such as airports, auxiliary landing fields, beacons, high tension lines, and magnetic courses. They are compiled from topographic maps of the United States Geological Survey, highway, post route, State and county maps, and from information supplied by organizations and individuals. Flights are made over the area covered to check the accuracy of the compilation. The Coast and Geodetic Survey is the distributing agency for these maps as well as the strip maps of the air corps of the United States Army. The price is uniform at 35 cents per copy with a reduction being allowed of 10 cents per copy on orders for 20 or more maps.

Those interested should write the Bureau direct at Washington, D. C.

Leveling streets in Minneapolis, Minn.

DAILY—several times a day, in fact, taxpayers and voters secretly re-elect the administration that gives them smooth, clean streets and roads. Good streets are first-hand evidence of administrative personality. Because most taxpayers know the economy of "Caterpillar" traction and appreciate the results of "Caterpillar" Road Machinery, municipal administrations usually find it less difficult to gain approval for other civic projects.

"... for the fewest taxpayers' dollars"

Prices—f. o. b. Peoria, Illinois

TEN	\$1100	TWENTY	\$1900
FIFTEEN	\$1450	THIRTY	\$2375
SIXTY	\$4175		

Caterpillar Tractor Co.

PEORIA, ILL. and SAN LEANDRO, CALIF., U. S. A.

Track-type Tractors / Combines / Road Machinery

(There's a "Caterpillar" Dealer Near You)

With Taxpayers' Approval



CATERPILLAR
REG. U. S. PAT. OFF.
TRACTOR

Clearing snow and ice from the gutters on Michigan Avenue, Chicago

Please mention PUBLIC WORKS when writing to advertisers.

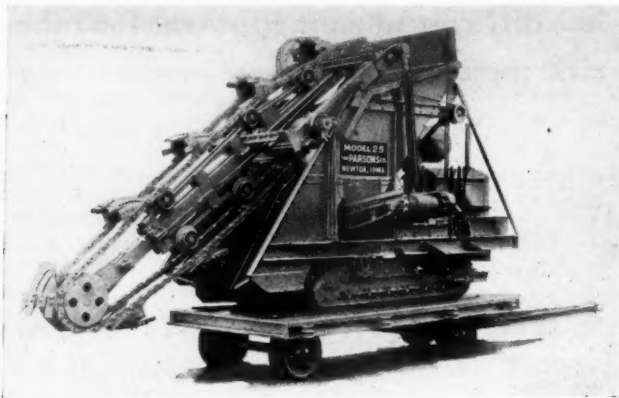
Engineering and Construction Equipment

New Machinery, Apparatus, Materials and Methods and Recent Installations.

New Parsons "25" Medium Size Ditcher

The Parsons Co., Newton, Ia., Division of National Equipment Corporation, has brought out the new Parsons "25" ditcher, which is designed for medium range trench work. Among the advanced features are:

1. Two bucket speeds which, synchronized with the four traction speeds,



New Parsons "25" Medium Size Trencher

enable the operator to show large output and save power.

2. Two speeds on conveyor, to adapt it to yardage load at various ranges of digging.

3. Full-crawler mounting on an improved 3-point suspension.

4. Enclosed transmission with ground shafting, heat-treated gearing and roller bearings. This single transmission contains every operation, including traction speeds and reverse, conveyor drive and reverse, boom hoist and reverse, bucket drive and reverse—a compact working unit, fully protected in an oil-tight case.

5. Conveyor frame of extra-heavy construction, to meet severe digging conditions.

6. Boom hoist through shaft equipped with flexible couplings and connected to pull direct on the roller carrying the boom carriage.

Because of its compactness, the Parsons "25" is easily handled, and easily moved from job to job. Where jumps are long, the machine rolls quickly up onto a trailer.

The Wiard Revolving Automatic Scraper

The Wiard Plow Co., Batavia, N. Y., have brought out their new automatic revolving scraper which is designed for excavating, grading and scraping. Owing to the advent of high powered tractors and other motive power, this machine has been built much stronger and heavier. It will last indefinitely without buckling or breaking, it is

claimed. The 4-foot size weighs 750 lbs. and the 5-foot 1000 lbs.

The 4-foot size carries $\frac{1}{2}$ cubic yard and with extension back will carry $\frac{3}{4}$ cubic yard. The 5-foot size carries one cubic yard and with extension back will carry 37 cubic feet. Broken stones, brick, slag, etc., can be moved with equal facility.

Both scraper and tractor are handled by one operator. Lever and trip are

within easy reach at all times. There is a continuous forward motion, when scraping, excavating or spreading; the scraper will revolve backward against the wall in cellar digging and will slide backward to dump the load over an embankment.

The positive excavation control is operated in accordance with the type of work to be done

or the character of the material to be handled. Control is flexible and the scraper may be set to fill the bowl in $3\frac{1}{2}$ feet or to skim the surface.

When the bowl is full it automatically moves into carrying position and the blade rides clear of the ground.

The load may be dumped accurately at any point desired, either in a heap or spread to any required depth; or it may be backed and dumped over an embankment or into trenches or ditches.

Features such as quick loading, the extension back, automatic control for excavating, spreading, backing and dumping, and one man operation make this the fastest working machine to its size known, it is claimed.

New Koehring Shovel With Enclosed Gears

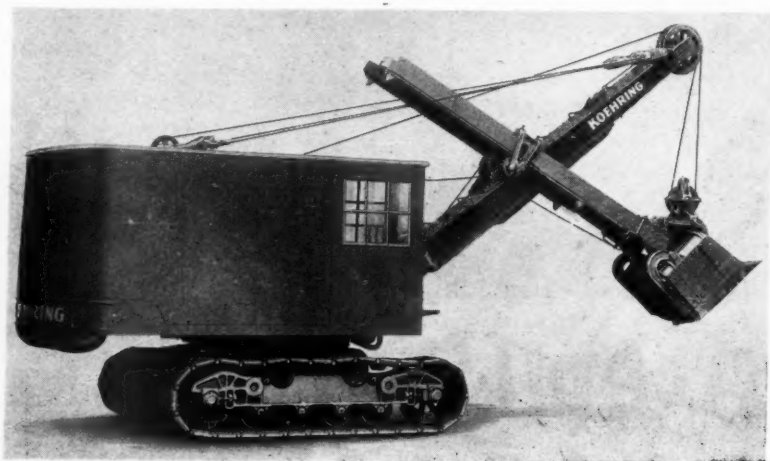
The Koehring No. 401 one-yard Shovel-Pull Shovel-Crane-Dragline has recently been brought out by the Koehring Division of the National Equipment Corporation, Milwaukee.

All gears except the turntable gear and swing pinion are enclosed and run in oil. All the machinery shafts, which enter into the operations of hoisting, drag, dipper crowd, boom hoist and swing, are mounted on roller or ball type anti-friction bearings.

The Koehring No. 401 machine by a simple handy quick gear shift has available two speeds for all operations. A high hoist line speed of 206 feet per minute, or a lower line speed of 162 feet per minute, hoists the dipper with either two or three part cable reeve. A still slower speed for rock work if desired may be had through the use of a different diameter for the drum barrel. These features of speed change by simple gear shift gives the Koehring Shovel a wide range of efficient adaptability for different operating conditions. It also makes interchangeability between shovel, pull shovel, crane and dragline very easy and quick to effect.

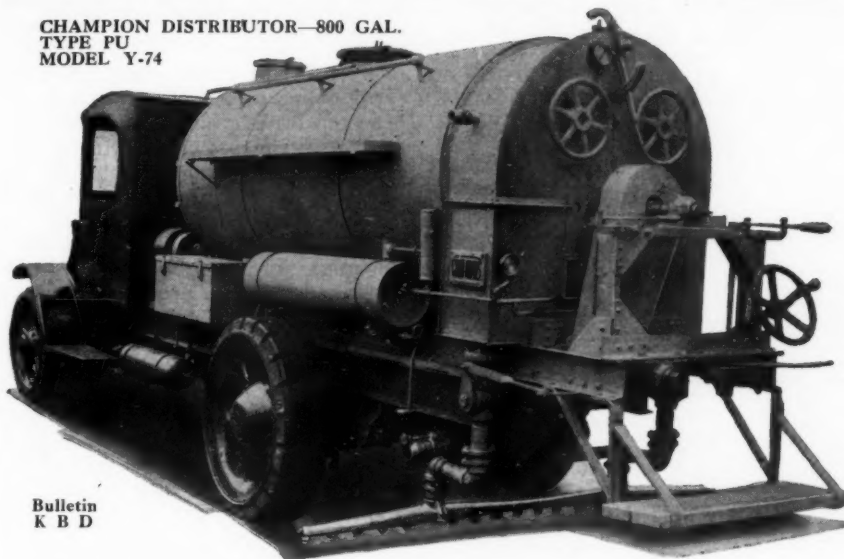
The specially designed Koehring self-cleaning multiplanes and shoes will be found on the new model with the old tried and proven long life grease sealed roller bearings and shoes with welded wearing plates.

Powered with a six cylinder Koehring-Wisconsin gasoline engine, $5\frac{1}{4}$ " bore by $6\frac{1}{2}$ " stroke, which delivers 100 horsepower (manufacturer's brake test rating) at 1075 R.P.M., the Koehring 401 has reserve power to handle the peak loads. The engine is equipped with a Stromberg carburetor, Bosch magneto, Pomona air cleaner, Kingston governor, combination gas



New Koehring Shovel No. 401—One-Yard

CHAMPION DISTRIBUTOR—800 GAL.
TYPE PU
MODEL Y-74



Bulletin
K B D

CHAMPION DISTRIBUTORS

Heater Type

FOR THE MECHANICAL APPLICATION OF ASPHALTS, TARS AND HEAVY PRODUCTS

Adaptable to mounting on any truck of sufficient capacity. Built in 600-, 800- and 1,000-gallon capacities—larger or smaller units furnished if desired.

Equipped with special VIKING Pumps—only two working parts—no plungers, valves or springs. 350 g.p.m. capacity. Reversible feature.

Heating system embodies internal fire-box principle eliminating warped shell or flue sheets and leaking flues.

On double unit, Type PU, power is furnished by 20-hp. LeRoi engine, located forward of tank. This location assures ample ventilation, a clean engine, protected when "backing up," and well away from burners—SAFETY FIRST.

NOW THE CHAMPION COLD APPLICATION OIL DISTRIBUTORS

Especially constructed for the application of the lighter road oils, requiring no preheating. Adaptable for mounting on small capacity, high-speed trucks.

An ideal distributor at an attractive price for any contractor, municipality, county or state roadway department.

Standard Sizes

500 gallon 600 gallon

Other sizes if desired

Adaptable to mounting on any standard truck chassis of sufficient capacity, equipped with power take-off attachment.

Bulletin KCO



NOTE THESE FEATURES

Flanged fittings with wire inserted asbestos gaskets. A non-leaking system

Tanks of fire-box steel. Our "rivet-weld" method insures double strength tank construction with minimum weight

No exposed piping

Tubes and flues of best charcoal iron

Manifolds are strongest and lightest known—from alloy of aluminum—lengths 4 feet to 26 feet

Snap connections for attaching manifolds and filling hose. No wrenches required—connections made in "seconds" not "minutes"

More heating area

Two-speed clutch. Amidship gear box. A multiplicity of pump speeds irrespective of truck speed

Self-aligning roller-bearings—Alemite lubrication fittings used throughout

Entire system protected by patented relief, control and check valve, meaning safety and simplicity in operation

Heating system embodies internal fire-box principle, eliminating warped shell or flue sheets and leaking flues

And many more equally important features



CHAMPION COLD OIL DISTRIBUTOR—ON GRAHAM
3-TON HIGH SPEED CHASSIS—MODEL RE S

The *Good Roads* Machinery Co. Inc.

"A business established and in continuous operation for fifty-two years at Kennett Square—in Pennsylvania."

NEW YORK
PITTSBURGH
FRANKFORT, KY.

Branches at

WATERTOWN, MASS.

PHILADELPHIA
CHICAGO

HARRISBURG, PA.

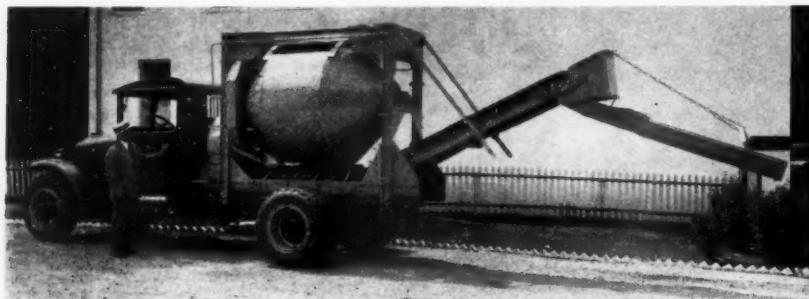
Please mention PUBLIC WORKS when writing to advertisers.

cleaner and AC fuel pump. The cooling system consists of a large size automobile-type radiator with a fan to blow the air away from the engine. Electric power is optional. The engine, upper machinery, counterweights and boom are all carried on the heavy steel turntable casting.

When built as a shovel the new Koehring handles a 1-yd. dipper on 16-ft. dipper sticks. Equipped for

New Truck Type Concrete Mixer and Carrier

Stephen Stepanian, vice president and general manager of the Arrow Sand and Gravel Company, of Columbus, Ohio, has developed a new type of truck mixer. This machine, although primarily a truck mixer, can be used for transporting premixed concrete; ready mixed mortar, sand and gravel and



Stepanian Truck Type Concrete Mixer and Carrier, Which Is Adaptable for a Wide Range of Uses

crane work it has a capacity of 13 tons at a radius of 12 feet with a 50% safety factor.

Western International Road Grader No. 32

The Western No. 32 International Road Grader is a one-man, patrol grader formed by combining a Western No. 32 grader with a McCormick-Deering 10-20 tractor. The combination is made easily by removing a few pieces from the front end of the grader and adding a few attachments, enabling the two machines to operate as a single unit.

The initial cost of this motor patrol is low; the cost of upkeep is low, and it costs little to operate. These features of economy, added to the unusual mileage the combination can cover, and the excellence of its work, make the unit a desirable one.

In operation the tractor pulls instead of pushes the blade. The tractor is connected direct to the front end of the blading unit. Its weight holds the blade against the reaction of the soil and prevents any skidding of the front end. This construction enables the machines to do effective work in hard material and in ditches. Moreover, a longer blade can be used than would be otherwise practicable.

The attachment of the grader to the tractor is but the work of a few minutes, involving the removal and addition of only a few pieces. There are no holes to drill. The attachments are all furnished ready to slip into place. Detachment is equally easy. The tractor is quickly available for other work when the grader is not in service. Rear crawlers may be attached to the tractor provided they do not extend around the front wheels. The front wheels must remain free to steer the unit.

crushed stone, and can also mix building mortar.

The mixer consists of a drum with a short cylindrical center section and frustum ends supported on a framework of structural steel shapes. The design of the mixer is such that no heavy cumbersome structure is required. The mixing blades are self-cleaning and give an unusually rapid and thorough mix because of the mixing motion. The drum is water, air and steam tight, the latter being an advantage when hauling hot concrete for winter construction. The water tank, which is easily connected or detached, does not add any extra height to the unit and the water is applied by gravity at both ends of the cone at a point above the mass in the mixer. This not only insures a rapid and uniform mix but a free flow of water as well. The mixer fits any standard truck, all structure of the unit being above the chassis of frame, and the entire unit is attached to the chassis by four bolts.

The mixer is loaded at the top direct from the bingates through a specially designed rack and pinion gate with

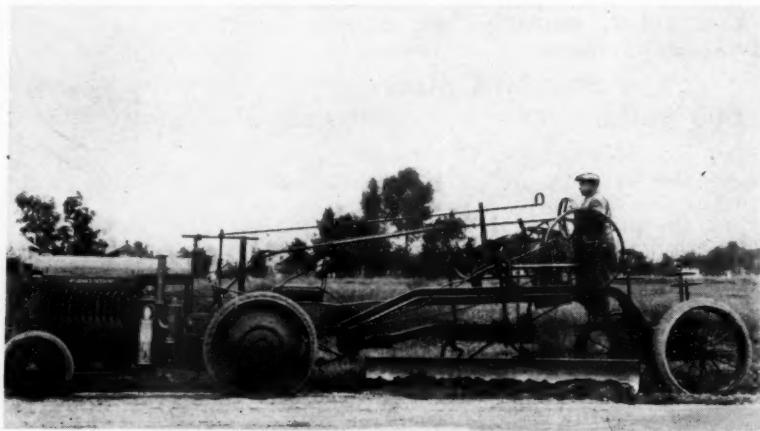
roller bearings. This is 12 inches wide and 34 inches long, allowing rapid loading or discharge and rendering the interior of the drum easily accessible for cleaning, inspection or repair. The open top loading eliminates any necessity of premixing of aggregates by means of special loading equipment and the drum does not revolve as the mixer is being charged.

To unload, the drum is turned until the gate is at the bottom. The material discharges onto an 8-ft. belt conveyor with a capacity of 2 cu. yds. per min. and adjustable to discharge at different heights up to 7 feet. A swinging chute at the end of the conveyor allows the concrete to be deposited within a radius of seven feet from this point. This chute folds underneath the conveyor when not in use or when in transit.

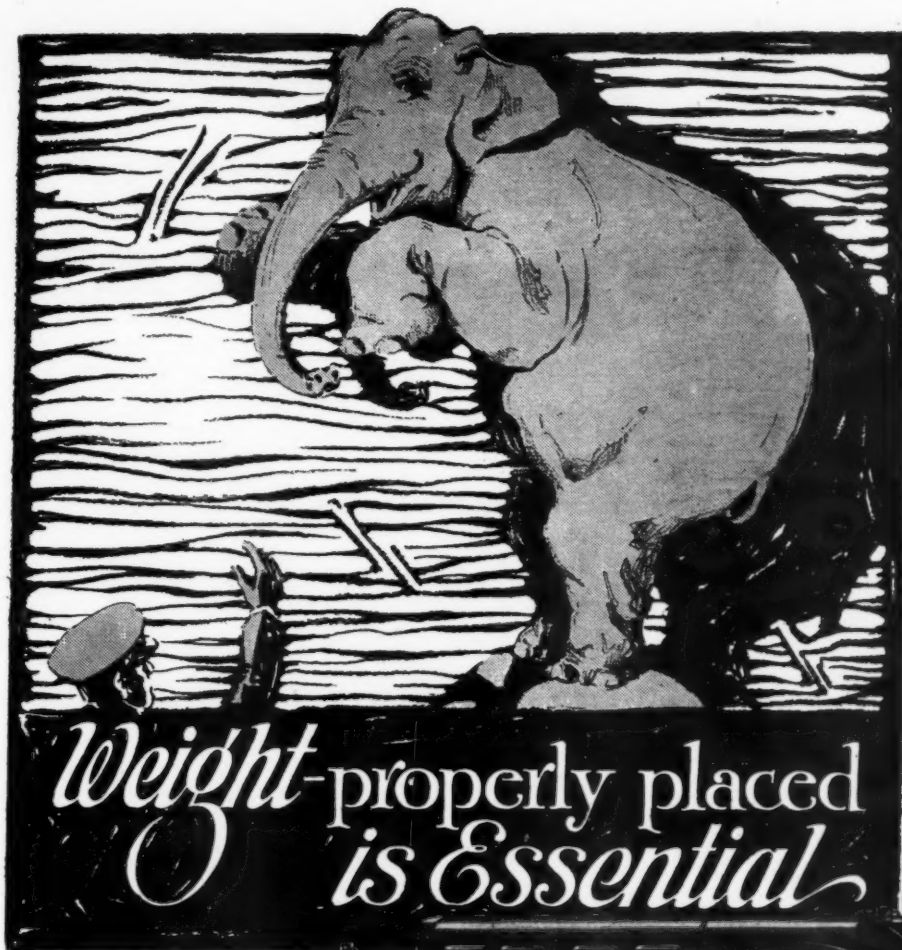
No hydraulic hoist is required to dump the contents of the mixer and there are no extra motors. Both agitator and conveyor are driven from the truck power plant by direct, chain, multiple belt, or gear drive as desired. The drive is mechanically simple and no special clutch is required as the gears are always in mesh. A single lever in the truck cab operates all the mechanism. When pushed one way it operates the mixer, and in the opposite position operates the belt conveyor. Only one can be operated at a time.

The rate of discharge of the concrete can be accurately controlled. The conveyor can be operated when the truck is in motion and its speed can be regulated by speeding up or slowing down the motor. This feature, together with the pivoted discharge chute, makes a flexible combination for all kinds of concrete placing. For curb or sidewalk work, for example, the truck can be moved along and the concrete can be made either in transit or at the destination as desired.

The 2½ yd. size is at present the only one being made. This is mounted on a 3½ ton truck chassis and has a total loaded weight of 12 tons. A maximum of 10 h.p. is required to operate the mixer and the application of power is uniform, with no high torque as in some types of mixers.



Western No. 32 International Patrol Grader



THE bulk of weight on all HUBER rollers is built in or directly above the massive rear rolls and is thus available at the direct point of road contact. Weight for weight, HUBER gives more compression per lineal inch under the rear rolls than any other roller. HUBER Motor Rollers are built for ALL ROAD JOBS—they are powerful, dependable, and economical to operate. All parts enclosed and easily accessible. Single lever control—ideal for one man operation.

A complete range of sizes—5 to 15 tons—provides a HUBER for every job you have to do.

A post card will bring you our catalog and many valuable facts about HUBER Motor rollers. Let us hear from you.

THE HUBER MANUFACTURING COMPANY

345 E. Center St., Marion, Ohio

HUBER

MOTOR ROLLERS

Please mention PUBLIC WORKS when writing to advertisers.

New Type Manometer Is Easy to Fill

With a view to overcoming the difficulty so often met with in filling the tubes of manometers of the usual type, the Meriam Co., 1955 West 112th Street, Cleveland, Ohio, have recently placed on the market a specially designed manometer with a larger bore of tube than that generally employed.

This not only makes it easy to in-

roduce the measuring liquid but also facilitates the disengagement of air-bubbles which would affect the accuracy of the readings—an especially important matter when measuring the flow of larger volumes of liquids or gases at low pressures; for such cases, of course, a slight error in the difference between the levels in the two legs of the U-tube might result in a decided error in the rate of flow.

A still further advantage of the larger bore is that the greater area largely neutralizes the capillary action of the sides of the tube, thus making the tops of the liquid columns less convex or concave, and therefore easier to read correctly. The makers state that the new type is finding favor among engineers, particularly in cases where the manometer must be re-filled frequently, as in portable instruments.

The increased size of bore does not of course in any way affect the actual differential level between the two legs of the tube, because this depends only upon the difference in pressure between the two points to which the instrument is connected.

Ingersoll-Rand New Type Air Compressor

Ingersoll-Rand Company, 11 Broadway, N. Y., announces a new line of air-cooled, two-stage air compressors, known as the Type 30. V-type belt drive is employed. Both motor and compressor have ball bearing.

The units are self-contained, the motor and compressor being mounted on a steel base, which is attached to the top

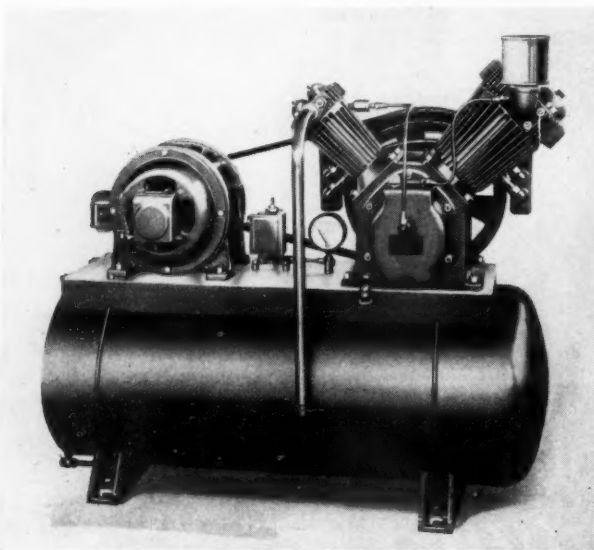
of the air receiver. The latter, which is made of heavy pressed steel, is built to withstand a working pressure of 200 pounds. With this arrangement, no special foundation is required for correct alignment of the compressor and motor. The compressor is ready to operate as soon as the electrical connections to the motor have been made and the crankcase filled with oil.

The intercooler is located behind the fan-type flywheel, and a constant cur-

rent of circulating air is driven directly across the cooling coils. This reduces the temperature of the discharge air.

Automatic start and stop control, furnished as standard equipment, operates independently, but in conjunction with the unloader. When the pressure in the air receiver reaches a point at which the regulator is set to unload, the motor is automatically shut off. A centrifugal governor allows the air in the high-pressure cylinder and intercooler to exhaust through the crankcase. This prevents the compressor from starting against a load.

Honed cylinders and two oil control rings reduce the oil in discharge air to a minimum. Each piston is run into its respective cylinder, insuring a perfect oil seal.



Ingersoll-Rand New Type Air Compressor With Ball Bearings

A self-cleaning air cleaner keeps dirt out of the compressor and requires no attention. The compressor is entirely enclosed, and no dirt can get into it to wear out the working parts. A balanced crankshaft eliminates destructive vibration.

This improved two-stage design reduces power from 10 to 30 per cent. At the same time, less floor space is required. It is built in four sizes: $\frac{3}{4}$, $1\frac{1}{2}$, 3, and 5 horsepower. All sizes are built for a working pressure up to 200 pounds continuous duty.

Austin 6-Cylinder Dual Drive Motor Grader

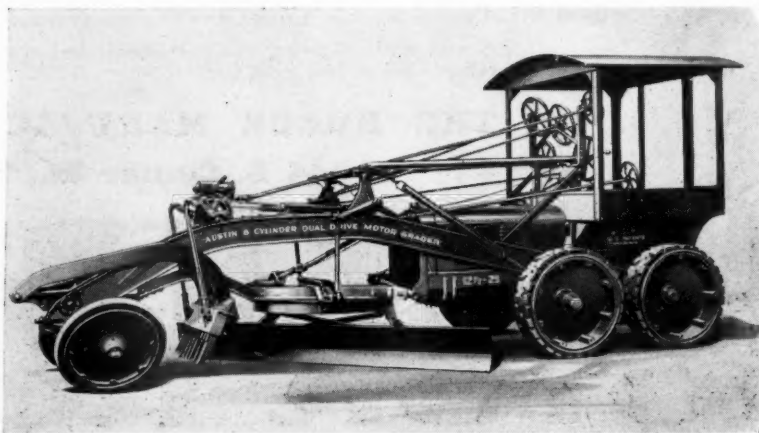
The increasing popularity of the Austin 10-20 and 15-30 Dual Drive motor graders has created a demand for a third model midway between the two in size and capacity. The new Model 12 $\frac{1}{2}$ -25 has been built to meet this demand.

Unlike the majority of motor graders, the 12 $\frac{1}{2}$ -25 is not built around a standard tractor, but, instead, is of Austin design throughout. For this reason, it not only possesses all the features of the 10-20 and 15-30 Dual Drive models, but also several features peculiarly its own, including a 6-cylinder motor and a unique type of driving mechanism of remarkable efficiency.

In the Austin 10-20 and 15-30 graders, the problem of relative power and traction was first solved satisfactorily. This was accomplished by combining the ground contact afforded by four drive wheels with the weight needed to insure freedom from slipping.

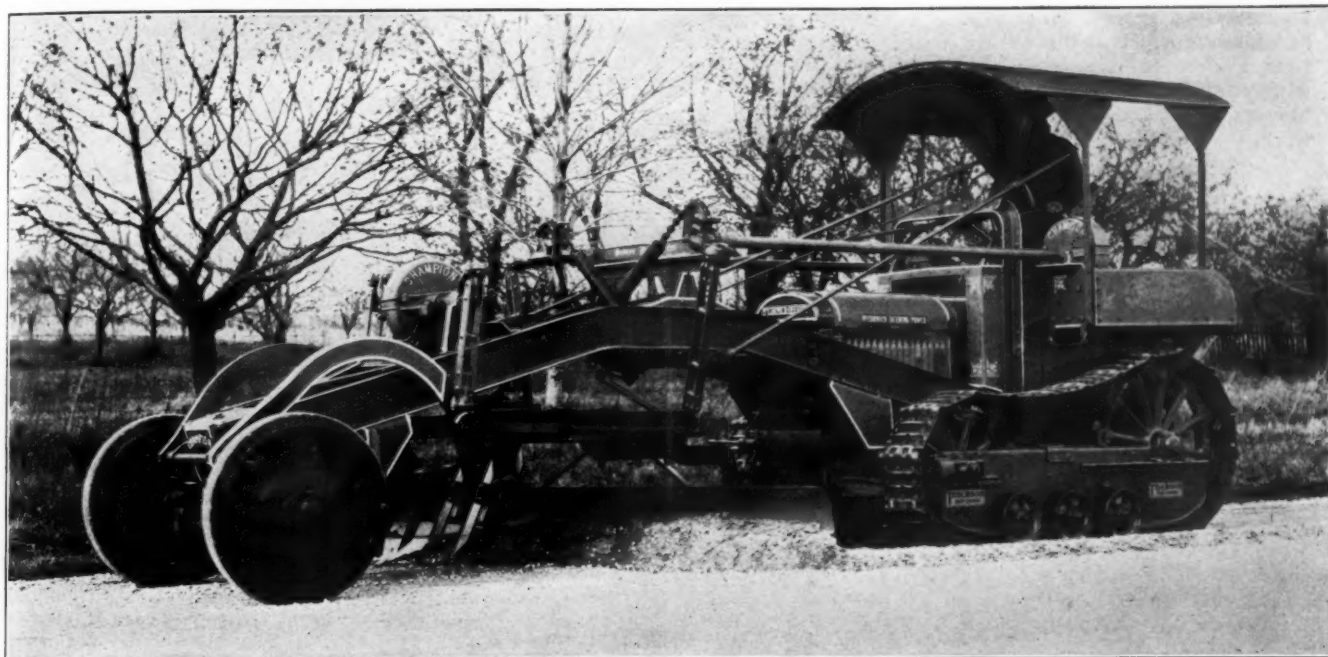
The new model 12 $\frac{1}{2}$ -25 is engineered to utilize the full power of its heavy duty, 6-cylinder motor. Sufficient ground contact is obtained by using 12-inch tires on all four drive wheels, and the weight carried on those wheels is, in turn, sufficient to insure the operating efficiency that has characterized previous dual drive models.

Unusual flexibility is provided by locating the differential driving shafts midway between the front and rear pairs of drive wheels, and mounting the right hand and left hand drive wheels separately on side arms which are pivotally connected to brackets enclosing the differential driving shafts.

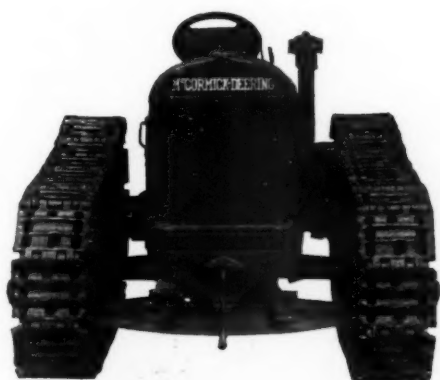


Austin 6-Cylinder Dual Drive Motor Grader

Improved Power Grader Performance



TRACKSON McCORMICK-DEERING



Model LH

MODEL LH Trackson McCormick-Deering is correctly designed for motor grader operation. Because of wide clearance between tracks and motor the grader frame can be mounted between them, thus insuring correct control and best results at the blade. Differential gears in rear end assure easy steering through front wheels of grader. No complicated clutch hook-ups necessary. No extra operations when turning. Corrugated track shoes provide ample traction without marring road surface. For unusual conditions one-bolt grouters can be quickly attached. No matter what grader you have or intend buying let us show you why Trackson Crawlers will improve its performance.

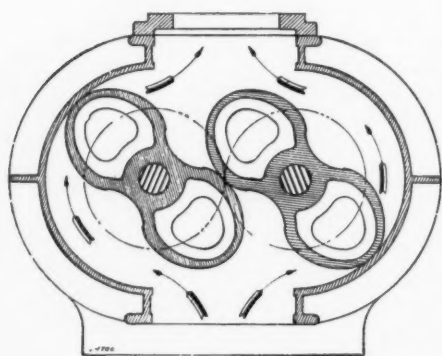
Trackson Company FULL-CRAWLERS & TRACTOR EQUIPMENT

1314 SOUTH FIRST ST. MILWAUKEE, WIS.

Please mention PUBLIC WORKS when writing to advertisers.

Blowers Especially Adapted for Sewage Aeration

The Connersville Blower Co., Connersville, Ind., manufacture a series of rotary positive blowers which are especially adapted to furnishing air for sewage treatment plants. The working parts in these blowers have no contact. Therefore it is not necessary to supply internal lubrication. On the other hand, because the clearances are so small no internal seal or "doping" of the impellers is required. Consequently, the air delivered is free from oil-fog or moisture spray. It is this ability to deliver a positive volume of clean air, without oil or moisture that makes these blowers so valuable in sewage aeration work.



Section Through Rotary Blower Showing Relation of Impellers

Operating at moderate speeds and moving the air at low velocities, Connersville blowers are subject to very little loss due to friction or heating. Correctness of design, good materials and careful workmanship combine to insure long operating life with a minimum degree of trouble.

This positive delivery of a definite volume of air is due to the action of the two impellers which rotate within the blower cylinder or casing, and as they

rotate, entrap between the lobes and the casing a volume of air which is carried toward the outlet opening. As the upper lobe of the impeller passes

dinary round wheel dump wagons. These wagons are designed for use with tractors of the crawler type. The large supporting area of the "Cat-Treads"



Davenport "Cat-Tread" Wagon

the edge of the opening the following lobe forces this air into the discharge pipe. This action assures the delivery from the blower of a constant volume of air as contrasted to the fan, in which air will only churn around in the casing, if the orifice is reduced or if there is resistance to free flow of the air.

Davenport "Cat-Tread" Dump Wagons

The Davenport Locomotive & Mfg. Corporation, Davenport, Iowa, manufacturers of the Davenport line of industrial locomotives for the past thirty years, have recently announced production of a new line of crawler type dump wagons. These are to be marketed under the name of "Davenport Cat-Tread" wagons.

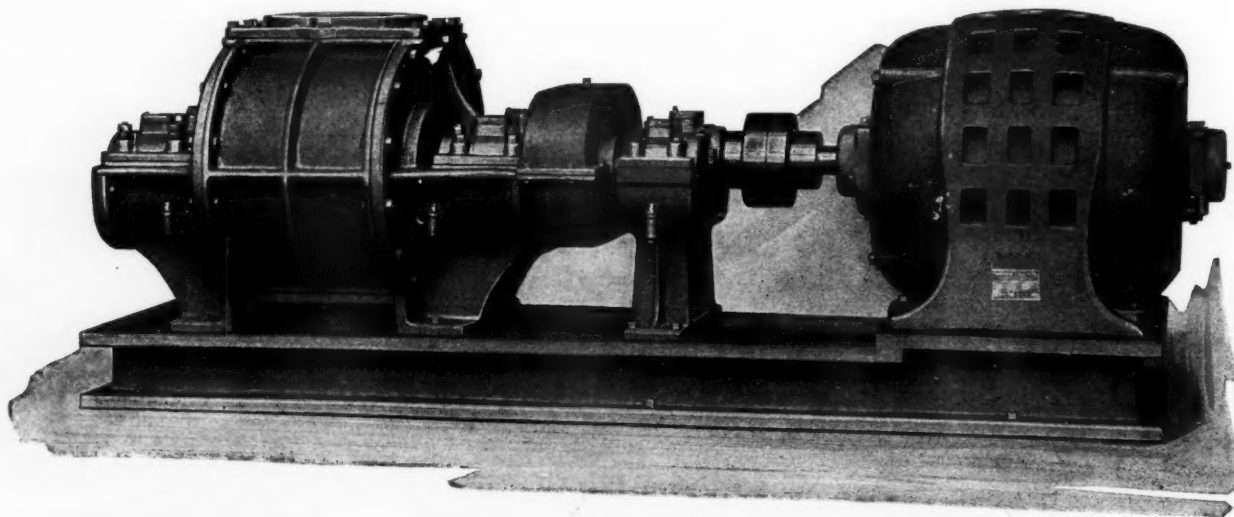
Cat-Tread wagons are especially adaptable for use on all types of earth moving operations where loading is done with powershovels or elevating graders. Their large capacity, combined with the ability to operate successfully regardless of weather or surface conditions, are factors which enable them to move much greater yardage than is possible with teams, and to continue working when conditions would prohibit the use of teams and or-

combined with the use of Timken bearings in the wheels make it possible to haul full loads with minimum tractive effort under the most adverse conditions.

Davenport Cat-Tread wagons at the present time are made in two sizes—of the 5 and 7-cu. yd. capacity. The 5-yd. wagon weighs 8400 pounds and the 7-yd. wagon approximately 10,500 pounds. Capacity of both wagons are based on level measures and these capacities are increased from one to two cubic yards by the application of an auxiliary side board which may be readily fitted to the low side of the dump body.

Cat-Tread wagons at the present time are made only with bottom dump. A simple, efficient and easily operated dumping and wind-up device is located at the rear. The dump doors drop vertically, permitting free discharge of the load and non-interference with the dumped material. It is contemplated by the Davenport Locomotive & Mfg. Corporation later to add further models to include a three-way dump body for use on jobs where it is necessary to dump over the edge of a fill or where other conditions may make it desirable for other than a bottom dump.

Among the special features claimed for Davenport Cat-Tread wagons, the following constructive features are im-



An "R-S-B" Blower Direct Coupled to Motor, Which in This Unit Is a Multiple Speed Type



Each of the two Blaw-Knox Central Mixing Plants which Wiley-Maxon Construction Company are using on the Columbia-Wrightsville Bridge consist of the following equipment—

A 500 barrel Cement Bin, equipped with a screw conveyor arrangement to transfer the cement to the Batchers on the 100-ton Blaw-Knox Batchers plant. This Batchers plant is equipped with a Volume Batcher and a Blaw-Knox Inundator. A Ransome Mixer is the mixing unit on each plant.

Two thoroughly reliable Blaw-Knox Central Mixing Plants—one at each end of the job—feature the concreting operations on Wiley-Maxon Construction Company's tremendous bridge project over the Susquehanna River.

Contractors have learned to rely upon the ability and experience of Blaw-Knox to furnish efficient plants for central mixing. Blaw-Knox Central Mixing Plant installations have made it possible to produce specification concrete on thousands of jobs, large and small.

Permit Blaw-Knox to make recommendations for your Central Mixing Plants. You will be placed under no obligation if you avail yourself to this engineering service.

BLAW-KNOX COMPANY

2010 Farmers Bank Bldg., Pittsburgh, Pa.

New York Cleveland Philadelphia Chicago
Detroit Birmingham Boston Buffalo Baltimore

Export Division:

Miliken Bros.—Blaw Knox Corp., Canadian Pacific Bldg.,
New York

BLAW-KNOX

Please mention PUBLIC WORKS when writing to advertisers.

portant: the Cat-Tread assembly is very rugged in all details and is rated at 15 tons capacity; the tread assembly is of special analysis steel specified because of its tough, wear resisting quality; the one-piece wheels which carry the treads are assembled in an "H" frame which it is claimed keeps the wheels in con-

New Mack Six for Fast Service

The latest addition to the line of Mack Trucks, Inc., is Model BG, a six-cylinder 1½-ton truck for fast service. Adapted to a wide variety of bodies, this chassis is available in three standard wheelbase lengths of 138, 158 and 168 inches.

The new unit is powered by a Mack six-cylinder engine which develops 75 horsepower at 2,600 r.p.m. Due to the relatively small bore, trunk type cast-aluminum pistons are successfully used with high compression. Smooth running at all speeds results from the counter-balanced crankshaft and the use of a vibration damper at the front end. The crankshaft as is customary on all Mack models is case-hardened. Full pressure lubrication supplies main and connecting rod bearings and the camshaft bushings, while overflow from the pressure relief valves, lubricates the timing gears. All oil is filtered through an H. W. filter. Fuel feed is by a vacuum tank, with a venturi-type booster. The engine has refinements such as cold circulation type thermostatic water temperature regulation, crankcase ventilation through the carburetor,

and battery distributor ignition, with the distributor at the top of the engine, and semi-automatic advance. An air maze filter is also supplied.

The four-speed selective transmission is driven by a multiple disk clutch, is provided with a power take-off opening and built in speedometer drive, and affords four forward speeds. Employing the new Mack worm and sector steering gear with eccentric adjustment for sector wear, the steering system pro-

vides a surprisingly short turning radius.

All springs are mounted in Mack rubber shock insulators, are of the semi-elliptic type, and are made of special alloy spring steel.

Conforming to the harmonious lines of the chassis, the Model BG cab is of the fully enclosed coupe type with wide entrance door and high head clearance. The gasoline tank which has a capacity of 20 gallons is located under the driver's seat with filler spout and gage at the right side of the cab.

Four wheel mechanical brakes of the fully enclosed expanding type with vacuum booster actuation, constitute the foot brake system while the hand brake is mounted independent on the drive shaft.

Scott Six Crawler-Type 30-HP. Tractor

The Scott Engineering Corporation, Charleston, W. Va., manufacture a crawler type tractor with a built-in two-drum hoist and a complete line of accessories to adapt this machine to all kinds of construction work. The tractor is powered with a 30 h.p. six-cylinder Continental motor. The outstanding feature of the tractor is its method of steering which permits the reversal of direction of either track at the will of the operator. This makes it possible to pivot the tractor on its center. In handling loads with a crane, boom or shovel attachment, by this method, the ground itself is used as a turntable and the load does not become out of balance sideways as it is always on the center line of the tractor. It is also mobile, as it is possible to lift a load and travel with the crawler treads to the new positions. Two crane types are made, one handling loads up to 1,500 pounds and the other handling loads up to 3,500 pounds on a boom swing of 14 feet. The tractors have electric starting and lighting equipment, special oil type air cleaner, two-drum hoist and double power take-off as standard equipment. The frames are drilled for the installation of additional equipment.



Loading a Davenport Wagon With an Elevating Grader

stant alignment and prevents broken or twisted axles when operating over uneven ground.

Cletrac Thirty "Swamp Special" Tractor

The Cleveland Tractor Co., Cleveland, Ohio, has brought out a "Swamp Special" of their 30 tractor which is especially designed for work in swamp or bog land, or where extreme conditions of mud or loose sand prevail. Designed originally for use on the construction of the great air terminal now being built on the Jersey meadows near New York, it fills a wide need for powerful equipment on other jobs where the footing is unstable.

The Model "30" Swamp Special is, in general construction, the same as the model "30" Cletrac. The difference in design is found in the provisions made for the installations of the wide tracks with which the Swamp Special is equipped. The track shoes with grouters attached are 22 inches in width. Length on the ground of each track is 73 inches. The total tractive surface is 3080 inches. As a result the ground pressure is reduced to the very low minimum of 26 pounds per square inch.



Scott 6Cylinder 30-HP. Crawler Tractor

Smashing Power in the **THEW LORAIN 75^B** ***Gas, Diesel or Electric***

- a big powerful motor that pulls the shovel through the peak loads without a whimper
- 1¼ yd. capacity with the ruggedness of a 1½ yd. machine
- all the features of the Thew Center Drive; simplified design, fewer parts to wear, and flexibility in operation.

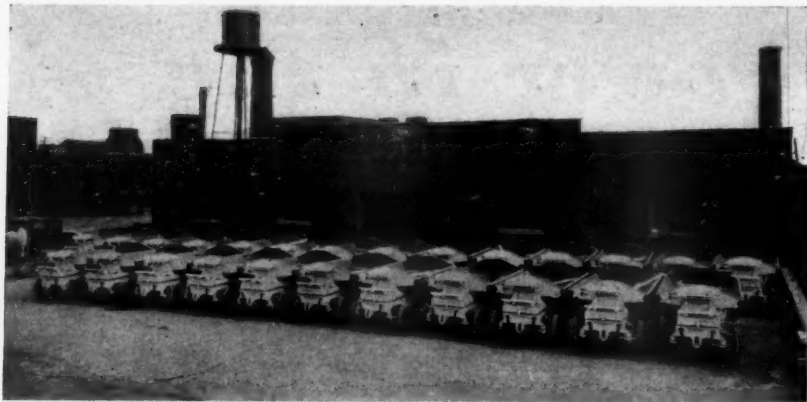
You can't be sure you are getting the most for your money until you have investigated the Thew Lorain 75^B.



**THE THEW
SHOVEL CO.
LORAIN, OHIO**

THEW LORAIN

Please mention PUBLIC WORKS when writing to advertisers.



Twenty-five New Trailers for Detroit Refuse Collection Service

A fleet of twenty-five Fruehauf municipal refuse trailers was recently added to the large fleet already operated by the City of Detroit. Such equipment provides one solution to the waste collection problem—a problem which faces every civic government and one that is constantly growing in seriousness. These trailers are of all steel construction, with a capacity of $4\frac{1}{2}$ cubic yards. They are of the reversible type having knuckle steering at one end and circle steering at the other. The circle steel allows the trailer to be jack-knifed and turned in

very narrow alleys. The trailers are pulled from house to house by horses and, when loaded, hauled in trains of three or four by motor trucks. Because of this, the knuckle and circle steering is a most important feature. It prevents all wobbling and snaking of the trailers and the train can be hauled along city streets with perfect safety. The saving often effected by this type of equipment and the flexibility of such a system of waste collection, are responsible for the growing preference for trailer equipment in many progressive centers.

News and Notes From the Industrial Field

Layne & Bowler, Inc., Memphis, Tenn., announce the establishment of two new subsidiary companies, making fourteen subsidiary companies who are distributors of Layne equipment. The new companies are: The Layne-Northwest Co., 1023 Wells St., Milwaukee, Wisc.; and the Layne Canadian Water Supply Co., Ltd., Toronto, Canada.

The State Highway Department of Missouri has placed an order for eight more FWD trucks. They are $3\frac{1}{2}$ -ton Utility Sixes equipped with 38 by 9-inch pneumatic tires, cab, and body.

The Trackson Company, Milwaukee, Wis., announces the appointment of the L. A. Snow Company, 134 International Right of Way, Spokane, Wash., as distributors of Trackson Tractor Equipment for McCormick-Deering Tractors in the Spokane territory.

The Trackson Company, 500 Clinton street, Milwaukee, Wisconsin, announces the appointment of the following distributors who will handle their full line of equipment for the McCormick-Deering Industrial Tractor: H. W. Moore Equipment Company, Sixth and Acoma, Denver, Colorado, covering the Denver territory; Steel Products Corporation, 919 Texas street, El Paso, Texas, covering most of New Mexico and Arizona, and the States of Chihuahua and Sonora, Mexico; Queen City Supply Company, Cincinnati, Ohio, covering the Cincinnati territory; and

the Ohio Valley Truck & Equipment Company, Marietta, Ohio, covering the Parkersburg, W. Va., territory.

The Portland Cement Association announces the appointment of James R. Fairman to be Manager, Eastern Offices, with headquarters at 347 Madison Avenue, New York City, succeeding B. H. Wait, resigned.

The Byers Machine Company, Ravenna, Ohio, announce that the W. H. Anderson Tool and Supply Company of Detroit, Michigan, has been appointed as their Michigan distributor.

The Central Iron & Steel Co. of Harrisburg, Pa., announces a change in the address of their Boston office, which is now Statler Office Bldg., Park Square. G. T. Armstrong still remains in charge.

The Young Radiator Company announces the issuing of its second group of insurance policies to some 158 employees through cooperation with the Metropolitan Life Insurance Company. This is a plan inaugurated by the officials of the company for the employees and offered to both the factory and office workers in line with its policies to take care of its employees, many of whom have been long with Mr. Young's interests. The first similar policies were offered over one year ago.

The Caterpillar Tractor Co., Peoria, Ill., has sold 1,360 tractors and 650 combines to the Russian government. There will be 50 Americans sent to supervise the use of this equipment. The contract by the Russian government with the Peoria company is stated to total more than \$6,000,000.

The Chain Belt Company, Milwaukee, has opened a New England district office in Boston at 950 Park Square Building. This makes the eighteenth district office the company has opened in the United States within a comparatively few years. J. K. Merwin is district manager.

Price reductions on every major item of machinery it makes—for farm, road building, logging and construction—have been announced by the Caterpillar Tractor Co.

On road graders and combined harvesters, the reductions are quite marked, ranging from \$100.00 to \$520.00 per unit. On road graders and maintainers, now manufactured at the Minneapolis factory, the reduction is as high as \$300 on the "20" motor patrol.

This is the sixth reduction in "Caterpillar" Tractor prices. In this four-year period the Sixty "Caterpillar," for example, which sold at around \$6,000.00 in 1925 now lists at \$4,175.00—a saving to the purchaser of \$1,825.00.

Within the next ninety days the Company will employ an additional 2,000 to 3,000 men in its enlarged combine and tractor factories and foundry at Peoria, which are nearing completion. This will make a total of from 6,000 to 7,000 at this plant, in addition to the 1,200 employed at its plants at Minneapolis, Minn., and San Leandro, Cal.

The Trackson Company, 500 Clinton street, Milwaukee, Wis., announces the appointment of the Stannard-Arnold Machinery Company, 149 West Second South street, Salt Lake City, Utah, as distributors of Trackson Tractor Equipment for the McCormick-Deering Tractor. The territory they will cover consists of Utah, and part of Idaho, Nevada, and Wyoming. They are in position to fill orders and furnish repair parts promptly.

The Foote Company, Inc., Nunda, N. Y., announce the appointment of The Hubbard-Floyd Company, Inc., 167th street and Sedgwick avenue, New York City, as their representative for the territory in Connecticut, New York and New Jersey adjacent to New York City. The Hubbard-Floyd Company will represent The Foote Company in the same territory as that handled by Frank E. Hall, whose recent death, and the closing of his estate, makes this necessary. The Hubbard-Floyd Company have a large modern warehouse and shop in connection with their offices at the above address, and a large force of mechanics. They will carry a stock of parts on hand for Multi-Foote Pavers.

THE ROME HIGH LIFT GRADER IS A BANK SLOPER



The "ROME" does the job exactly to your specification without any troublesome attachment. Works equally well on low or high cuts. Always available in one minute's time, and again ready for grading or ditching in thirty seconds. This is only one of many valuable features incorporated in "ROME" design. You will not know about the latest in Road Grader design and construction till you have seen the "ROME." Remember—THE BEST BARGAIN IS QUALITY—See your nearest "ROME" dealer, or write us for catalogue.

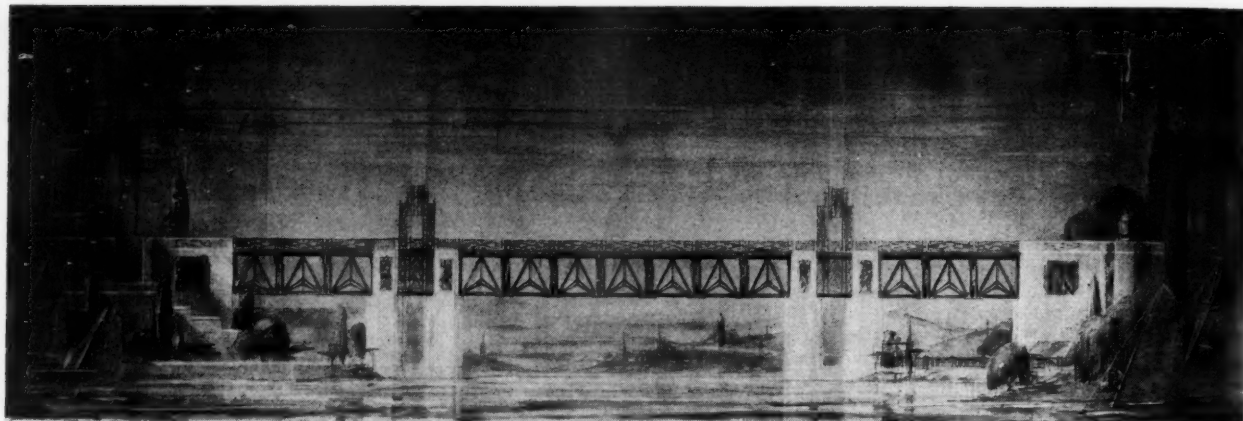
ROME MANUFACTURING COMPANY, GRADER DEPARTMENT

Division Revere Copper and Brass Incorporated

ROME, NEW YORK

Exclusive Manufacturers Rome "High Lift" Graders and Rome Motor Graders

Please mention PUBLIC WORKS when writing to advertisers.



Engineers believe that a bridge in steel can be as artistic in appearance as it is economical in construction. To prove this an annual competition among architectural students, through the Beaux-Arts Institute of Design, has been established, and the first won by W. Kleinman, a student of the University of Illinois. Mr. Kleinman believes that a bridge should take cognizance of modern developments, so he suggests that its piers shall be surmounted by beacons for the guidance of aviators at night.

The Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago, Illinois, announces the following organization changes: R. E. Kelly, formerly manager of the Boston office, has been made Sales Engineer for the Eastern District with headquarters in New York. John Ashton, salesman in the New York district, has been appointed manager of the Boston office.

The National Equipment Corporation—a consolidation of the Koehring and T. L. Smith Companies of Milwaukee, the Insley Manufacturing Company of Indianapolis, the Parsons Company of Newton, Iowa, and the Kwik-Mix Concrete Mixer Company of Port Washington, Wisconsin—became an operating company on January 1st, 1930. Philip A. Koehring is president and general manager of the National Equipment Corporation, with headquarters at 31st Street and Concordia Avenue, Milwaukee.

Sales, service, advertising and accounting departments have been centralized thereby rendering a more efficient service to customers, as well as effecting economies in operation, and overhead. R. E. Brooks, for a number of years engaged in the equipment business in New York, was recently elected vice-president and will be in charge of sales.

The Cleveland Tractor Company of Cleveland, Ohio, makers of Cletrac Crawler Tractors, have just announced the receipt of another large order—this time for 708 Cletrac Crawler Tractors from the Soviet Government through the Amtorg Trading Company of New York City. Including this order a total of over 1,300 Cletracs have been purchased by the Russian Government during the past year.

Among the uses to which these tractors are put are: farming the great agricultural sections of Russia; building and maintaining highways; construction work; logging; oil field and mine work and the big task of hauling supplies across Russia's vast regions.

The Chain Belt Company, Milwaukee, has opened a New England district office in Boston at 950 Park Square Building. This makes the eighteenth district office the company has opened in the United States within a comparatively few years. J. H. Merwin is district manager.

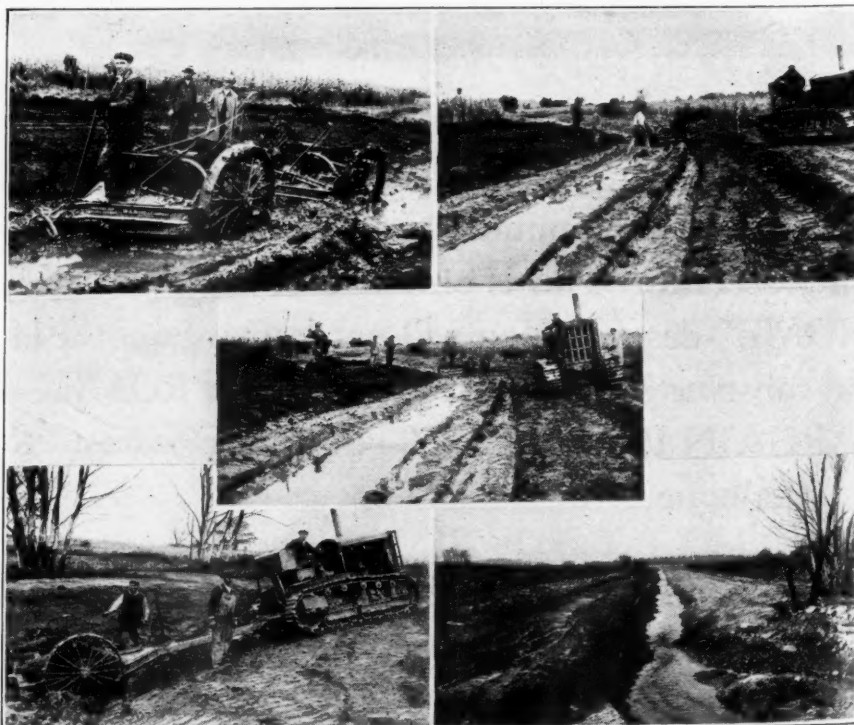
The Ford Motor Company of Dearborn, Michigan, have ordered one 600-hp. and one 300-hp. Oil-Electric Locomotive from the Ingersoll-Rand Company for the Rouge River Plant. These locomotives will be furnished with General Electric Equipment and will be built at their Erie Works.

Wheeled Scoops Save on Ditch Relocation

To eliminate trouble due to overflowing and damaging State Route 98, the Ohio Highway Department undertook a relocation project along Brokensword Ditch. A new channel $\frac{3}{4}$ miles long, 50 feet wide at top, 6 feet wide at bottom and 10 feet deep was cut with Warco scoops and tractors. Extreme working conditions were encountered including everything from stiff blue clay to quicksand. By the use of this equip-

ment, the work was completed at a cost \$2,000 below the estimate.

These accompanying pictures show how the scoops were operated in the mud by two tractors and a cable. Dumping was accomplished by towing with one tractor. The bottom picture at the left shows a scoop with tongue at work where no other type of equipment could have been used. Below at the right is the finished ditch.



Warco Scoops Save on Ditch Relocation

WARCO

WHEELED SCOOPS

EXCAVATE, HAUL AND DUMP
IN CONTINUOUS CYCLES, OPERATED
IN TRAINS BY ONE MAN. USE AS
MANY AS YOUR TRACTOR WILL PULL



THERE IS NO MORE ECONOMICAL KNOWN
METHOD OF MOVING EARTH ON SHORT HAULS
THAN A TRAIN OF —

WARCO WHEELED SCOOPS



W.A. RIDDELL COMPANY BUCYRUS OHIO, U.S.A.
POWER & DRAWN GRADERS - WHEELED SCOOPS - REAR TYPE CRAWLERS

The Fate-Root-Heath Company (Plymouth Locomotive Works), Plymouth, Ohio, has just completed a large new factory unit, of steel and brick construction. New equipment, which is now being installed, will double the present output of the Plymouth gear-drive gasoline and Diesel locomotives. The company also manufactures gas-electric and Diesel-electric locomotives from 20 to 100 tons.

Trade Publications

Surveying Instruments.—Warren Knight Co., Philadelphia. Fifty-two pages; instructions on how to check and make adjustments to a wye level; how to read the vernier; illustrates and describes six of the usual problems encountered in ordinary use with instructions as to how the problems can best be solved by the use of a level. The book includes in addition to the instructions, a small catalog of engineering field equipment and drafting room sup-

plies and space for the owners record pertaining to adjustments and maintenance, repair and depreciation costs to his instrument.

Final Report on Cross Connections.—Reprinted from Journal of New England Water Works Association. Published by Wallace & Tiernan Co., Inc., Newark, N. J.

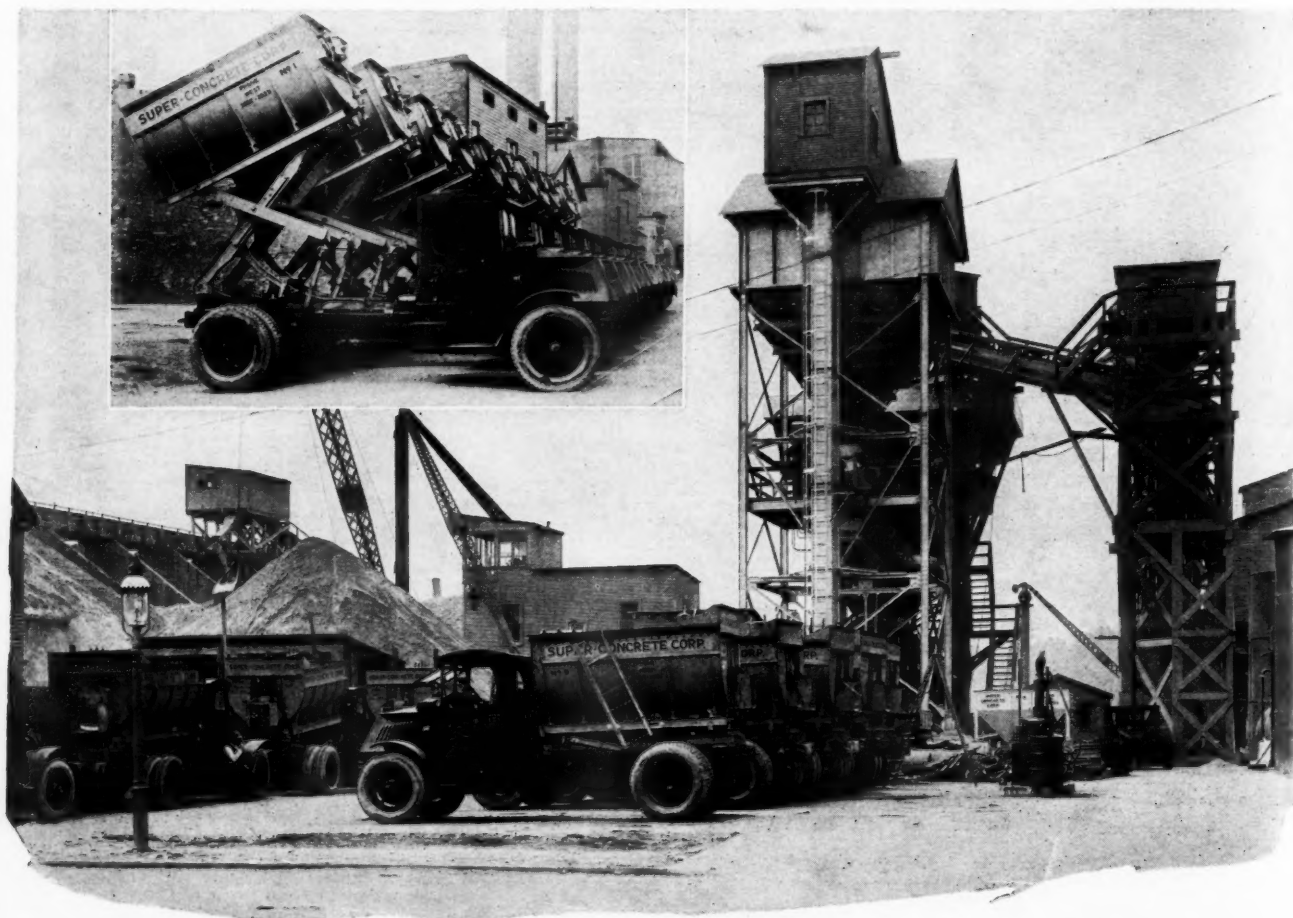
Air Compressors.—Type 30, Ingersoll-Rand two-stage, air-cooled, ball-bearing air compressors are described in a 12-page catalog just published.

Chausse Oil Burners.—A new catalog covering equipment for the maintenance of roads and streets has been issued by the Chausse Oil Burner Company of Elkhart, Indiana, who state that this is the most complete booklet on such equipment which has ever been issued. The new catalog describes and illustrates machinery for repairing and resurfacing asphalt, concrete and brick highway surfaces, such as portable asphalt plants, both mechanically operated and hand mixing. Among the other equipment described are concrete

mixer heaters, self-heating smoothing irons, railway switch heaters, kerosene torches, fire wagons, surface heaters, and lead melters. Many illustrations are given of these various devices in active service. The Chausse Company states that this catalog is being sent out only by request.

Outdoor Switchhouses.—Westinghouse Outdoor Switchhouses is the title of an eight page booklet C-1861 published by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. The application, distinctive features, construction and advantages of outdoor switchhouses with manual, motor or solenoid-operated oil circuit breakers are given. General and equipment specifications are listed in full for each of the three different types, with a description of the automatic reclosing equipment, which is available for all electrically operated breaker equipments and is recommended for all feeder circuits. Outline dimensions and drawings of the different types of switchhouses complete the circular.

A Wet-Mix Fleet in Washington



The Super-Concrete Corporation, Washington, D. C., operate ten units in their wet-mix fleet. These are equipped with Wood "Hi-lift" hoists and are powered by Wood type M-5 mechanical hoists. Three dumping positions can be obtained through the control rod—to 62 degrees as a straight end dump, to 42 degrees as an intermediate Hi-Lift, and to 30 degrees at full lift position. Graham concrete agitators, capable of handling 3-cubic yards of wet-mix concrete are mounted on model AK Mack chassis.



WHEN YOUR SAVINGS DEPEND ON CUBIC YARDS HAULED

More time saved, more material hauled, lower costs effected — the aim of every far-seeing public official. And in the fulfillment of that end, motor trucks play an important part.

Hundreds of public officials — and tens of thousands of other business men — have found Dodge Trucks able allies. Regardless of weather or road, Dodge Trucks work dependably always. They are geared for time-saving speed and acceleration. They are sturdily built for gruelling service. They are easy to maneuver on the road or ahead of the road. They are economical to operate and maintain — throughout their unusually long lives.

Buy a Dodge Truck with assured safety to your investment. It will enable you to save more time, haul more material and lower your hauling costs.

DODGE TRUCKS

Westinghouse Achievements, 1929.—Special publication, 1717-D, Engineering Achievements of the Westinghouse Electric and Manufacturing Company during 1929. Annual review. 36 pp. Illustrated. Copies may be obtained from PUBLIC WORKS by using the coupon on page 77, and asking for No. 1000.

Tractor Shovel.—Catalog T5, 24 pages and color feature the Bay City Tractor Shovel, ten-ton, $\frac{3}{4}$ -revolving, $\frac{3}{8}$ -yard capacity, convertible power shovel, crane, trench hoe, dragline and backfiller with full crawler mounting and powered by McCormick-Deering Industrial Tractor. Catalog contains illustrations of machines at work with each type of boom and bucket.

Half-Yard Shovel.—Catalog K2, 20 pages and cover featuring the Bay City Model K full revolving, half yard shovel, clamshell, skimmer, trench hoe and dragline; weight 15 tons, full revolving swing; with illustrations showing equipment in service with each type of boom and bucket.

Solving Power Factor Problems with Scale.—The General Electric Company announces a graphic method of solving power factor problems involving simple computations only. This is described fully in "Solving Power Factor Problems by Scale."

Heretofore the calculations relating to power factor and its improvement have been difficult, and did not visualize the conditions that might result from different treatments. In brief, the new system consists of laying down to scale the known factors and then scaling the unknowns. Many problems are illustrated in the booklet, as well as several solutions for one problem, so that there should be no difficulty in applying the simple rules. Thus the effects and probable costs of improving power factor by unity-power-factor synchronous motors, by capacitors or by synchronous condensers may be scanned and compared. Increased load-carrying capacity is readily measured and rearrangements suggest themselves.

All that is needed for computation is a scale, a pencil and paper. A right-angle triangle with the sides in proportion 3 to 4 to 5 is furnished with the booklet and this, together with a small T-square, save time in the calculations and make the work more accurate.

In the actual calculations, horsepower at unity-power-factor is expressed in terms of inches measured horizontally. Lagging power factor is represented by lines slanting upward to the right, and leading power factor, by lines slanting downward to the right. Where it is desired to improved lagging power factor, and to determine the amount of leading power factor necessary to accomplish this result, a triangle is laid out using the horizontal unity power-factor line and the upward lagging power factor line. Then by applying the 3-4-5-triangle the necessary corrective value may be established. Other problems are solved in a similar manner.

Cost Data for the Engineer and Contractor

2.98 Miles Concrete Road

Maryland State Roads Commission—Garret Co.

Bids Received Aug. 6, 1929.

1. Keeley Constr. Co., Clarksburg, W. Va.; 2. Tristate Co., Cumberland, Md.; 3. Engr. Development & Constr. Co., Baltimore, Md.; 4. Brady Bros., Frostburg, Md.

QUANTITIES	(1) UNIT PRICE BID	(2) UNIT PRICE BID	(3) UNIT PRICE BID	(4) UNIT PRICE BID
"Excavation," 20,100 cu. yds.....	.60	.80	.80	.92
"Borrow," 100 cu. yds.....	.60	.80	.80	.92
"One Course Pl. Cement Concrete Pavement," 9"x6.3", 28,250 sq. yds.....	1.75	2.00	2.04	2.45
"Class 'C' Concrete," 87 cu. yds.....	14.00	15.00	16.50	22.00
15" Cast Iron Pipe, 332 lin. ft.....	3.50	3.25	3.50	3.50
18" Cast Iron Pipe, 177 lin. ft.....	4.00	4.00	4.20	4.25
30" Cast Iron Pipe, 30 lin. ft.....	7.00	8.00	7.50	9.00
36" Cast Iron Pipe, 72 lin. ft.....	9.00	9.00	9.50	11.00
12" Corr. Metal Pipe.....	1.50	1.75	1.80	2.50
14" Corr. Metal Pipe, 32 lin. ft.....	2.00	2.00	2.00	3.00
16" Corr. Metal Pipe, 30 lin. ft.....	2.25	2.25	2.50	3.50
12" Corr. Metal Pipe (Relaid), 30 lin. ft.....	1.00	1.50	1.00	1.00
4" Vit. Tile Underdrain, 1,000 lin. ft.....	.40	1.00	.90	.90
4" Vit. Tile Outlets, 100 lin. ft.....	.50	.90	.70	.90
"Wire Fencing," 600 lin. ft.....	.65	.55	.80	.70
"Conc. Water Troughs," 1.....	35.00	75.00	60.00	50.00
TOTAL OF BIDS.....	\$67,356.00	\$79,263.50	\$80,698.10	\$95,837.25

Sheet Asphalt Pavement

Maryland State Roads Commission—Gwynns Fall Parkway, Baltimore, Md.

Bids received Aug. 6, 1929.

1. P. Flanagan & Sons, Inc., Baltimore, Md.; 2. Baltimore Asphalt Block and Tile Co., Baltimore, Md.; 3. American Paving & Contracting Company, Baltimore, Md.; 4. National Paving & Contracting Company, Baltimore, Md.

QUANTITIES	(1) UNIT PRICE BID	(2) UNIT PRICE BID	(3) UNIT PRICE BID	(4) UNIT PRICE BID
"Excavation," 1700 cu. yds.....	1.34	1.50	1.43	1.45
"Pl. Cement Concrete Base Course," 6", 13,100 sq. yds.....	1.15	1.27	1.31	1.35
"One Course Pl. Cement Conc. Pavement, 6"x6", 50 sq. yds.....	1.40	1.33	1.37	1.30
"Bit. Surface Course Specifications 'A'," 1½"x1½", 13,100 sq. yds.....	1.85	1.89	1.89	1.93
"Plain Cement Concrete Curbing," 7,950 lin. ft.....	.72	.75	.76	.77
"Armored Cement Conc. Curbing," 50 lin. ft.....	.87	1.10	.88	1.00
TOTAL OF BIDS.....	\$47,415.50	\$50,030.00	\$50,505.50	\$51,669.50

Bids for Hamilton, N. Y., Sewerage System

Henry W. Taylor, Consulting Engineer

11 Park Place, New York City

Contractors Bidding on Hamilton Sewerage

1. Di Luca Brothers, Utica, N. Y.; 2. Frank M. Johnston, 17 Carille Ave., Utica, N. Y.; 3. Saraceno & Mauro, Utica, N. Y.; 4. Ellis G. Della, New Hartford, N. Y.; 5. Fort Schuyler Eng. & Const. Co., Whitesboro, N. Y.

	Bid 1	Bid 2	Bid 3	Bid 4	Bid 5
Lump Sum Bid (a).....	93,537.94	96,790	104,000	107,350	111,655.35
Lump Sum Bid (b).....	85,591.54	88,100	97,000	99,180	104,155.35
Lump Sum Bid (c).....	6,250	8,500	4,450	7,250	5,000
Lump Sum Bids (a) plus (c).....	99,787.94	105,290	108,450	114,600	116,655.35
Lump Sum Bids (b) plus (c).....	91,841.54	96,600	101,450	106,430	109,155.35
UNIT PRICES—QUANTITIES					
1 (a) 8" sewer 5 ft. cut, 9,200 ft.....	.95	.65	.85	1.08	1.10
(b) 8" sewer 5-6 ft. cut, 12,300 ft.....	1	.80	.95	1.12	1.10
(c) 8" sewer 6-7 ft. cut, 4,700 ft.....	1	.90	1.15	1.22	1.10
(d) 8" sewer 7-9 ft. cut, 3,000 ft.....	1.50	1.25	1.45	1.38	1.15
(e) 8" sewer 9-11 ft. cut, 1,200 ft.....	1.50	2.25	1.85	1.62	1.50
(f) 10" sewer 6 ft. cut, 1,040 ft.....	1	.70	1.15	1.22	1.35
(g) 10" sewer 6-7 ft. cut, 920 ft.....	1	.90	1.35	1.32	1.35
(h) 10" sewer 7-9 ft. cut, 1,770 ft.....	1.50	1.20	1.65	1.48	1.50
(i) 10" sewer 9-11 ft. cut, 100 ft.....	1.50	1.75	2.50	1.72	1.75
(j) 12" sewer 4 ft. cut, 3,410 ft.....	1.25	.75	1.10	1.28	1.50
(k) 12" sewer 4-5 ft. cut, 500 ft.....	1.25	.90	1.35	1.28	1.50
(l) 12" sewer 5-7 ft. cut, 300 ft.....	1.25	1.15	1.65	1.42	1.50
(m) 12" sewer 7-9 ft. cut, 800 ft.....	1.50	1.35	1.95	1.82	1.75
2 (a) Manholes 5 ft. deep, 60.....	50	50	55	60	75
(b) Manholes 5-7 ft. deep, 50.....	55	65	65	65	85
(c) Manholes 7-9 ft. deep, 27.....	55	90	75	80	95
(d) Manholes 9-11 ft. deep, 9.....	65	110	100	100	110
(e) Manholes 11-13 ft. deep, 7.....	80	140	150	150	125
3 (a) 12"x6" Y Branches, 20.....	1.44	2	1.50	1.60	1.50
(b) 10"x6" Y Branches, 70.....	1.12	1.75	1.25	1.30	1.25
(c) 8"x6" Y Branches, 410.....	.55	1.30	1	1.00	1
4 Cast Iron Pipe per ton, 15 tons.....	75	100	80	75	125
5 Trench Sheathing per foot, 1,000 ft.....	100	60	90	50	60
6 House Laterals per foot, 5,000 ft.....	1.25	1.70	.89	1.45	1
7 (a) 6" Under drains per foot.....	1.25	.35	.70	.70	.40
(b) 8" under drains per foot.....	1.25	.80	.80	.80	.50
8 Concrete per cu. yd.....	20	18.50	24	18	30
Totals.....	59,355.20	56,133	58,417	67,559.60	67,853.50